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EDISON ELECTRIC INSTITUTE

STATISTICAL DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY

Compiled Monthly by the Edison Electric Institute—Covers 100% of the Industry

DURING THE MONTH OF APRIL

	1938	1937	%
	SOURCE OF ENERGY		
Kilowatthours Generated (Net)†			
By Fuel Burning Plants	4,681,036,000	5,489,354,000	−14.7
By Water Power	3,743,812,000	3,899,022,000	− 4.0
Total Generation	8,424,848,000	9,388,376,000	−10.3
Net Purchases			
From Other Sources	299,090,000	285,795,000	+ 4.7
Net International Imports	74,639,000	108,930,000	−31.5
Total Purchased Power (Net)	373,729,000	394,725,000	− 5.3
Total Input	**8,798,577,000**	**9,783,101,000**	**−10.1**
	DISPOSAL OF ENERGY		
Total Sales	**7,355,240,000**	**8,249,367,000**	(a)
Energy Not Reported as Sold			
Used in Electric Railway Departments	33,631,000	50,098,000	(a)
Used in Electric and Other Departments	145,657,000	143,364,000	(a)
Furnished Free or Exchanged in Kind	1,917,000	(Not Shown)	(a)
Total Not Reported as Sold	181,205,000	193,462,000	(a)
Total Energy Accounted For	**7,536,445,000**	**8,442,829,000**	**−10.7**
Losses and Energy Unaccounted For	1,262,132,000	1,340,272,000	− 5.8
Total Output (To check above **"Input"**)	**8,798,577,000**	**9,783,101,000**	**−10.1**

CLASSIFICATION OF KILOWATTHOUR SALES

Based on FPC Classification—April 1938		**Based on EEI Classification—April 1937**	
Residential or Domestic	1,571,341,000	Domestic	1,413,390,000
Rural	(Allocated to Other Classes)	Commercial—Small Light and Power	1,403,192,000
Commercial and Industrial	4,981,402,000	Commercial—Large Light and Power	4,685,036,000
Public Street and Highway Lighting	148,357,000	Municipal Street Lighting	179,844,000
Other Public Authorities	163,877,000	Street and Interurban Railways	372,146,000
Sales to Railroads and Railways	445,315,000	Electric Steam Railroads	111,087,000
Interdepartmental	35,986,000	Municipal and Miscellaneous	84,672,000
Other Sales	8,962,000		
Total Sales	7,355,240,000	Sales to Ultimate Customers	8,249,367,000

CLASSIFICATION OF CUSTOMERS

Based on FPC Classification—April 30, 1938		**Based on EEI Classification—April 30, 1937**	
Residential or Domestic	22,708,385	Domestic	21,925,392
Rural	(Allocated to Other Classes)	Commercial—Small Light and Power	3,835,692
Commercial and Industrial	4,533,287	Commercial—Large Light and Power	550,996
Public Street and Highway Lighting	26,006	Municipal Street Lighting	34,504
Other Public Authorities	74,185	Street and Interurban Railways	323
Railroads and Railways	289	Electric Steam Railroads	26
Interdepartmental	304	Municipal and Miscellaneous	38,288
Others	3,506		
Total Customers	27,345,962	Total Ultimate Customers	26,385,221

REVENUE (b)

Based on FPC Classification—April 1938		**Based on EEI Classification—April 1937**	
Revenue from Sales Excluding Sales to Other Public Utilities	$174,575,300	Revenue from Ultimate Customers	$177,183,800
Other Revenue	1,842,400		
Total Revenue	$176,417,700		

ESTIMATED DOMESTIC ELECTRIC SERVICE RATIOS

(For the 12 Months Ended April 30th)

	1938	1937	%
Kilowatthours per Customer	821	756	+ 8.6
Average Annual Bill	$35.58	$34.52	+ 3.1
Revenue per Kwhr	4.33¢	4.56¢	− 5.0

(a) Data for two years not strictly comparable.
(b) Data not comparable because of an unascertainable amount of "Revenue" in April 1938 which may or may not have been included in the 1937 data.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 6 JULY, 1938 No. 7

Electricity in the Economic Picture

By C. W. Kellogg
President, Edison Electric Institute

A paper presented before the Institute of Public Affairs, Charlottesville, Va., July 9, 1938

PRESUMABLY the reason I, representing the electric utility industry, have been asked to speak on your program covering economic stability and social security is the belief on your part that the relative economic importance of electricity in the economic picture is measured by the amount of publicity it has received in recent years; for, from the viewpoint of cost, electricity is not an important item. I feel, therefore, that I should begin by stating the relative facts about the electric utility business in the economics of our country.

The sources of electric revenues are approximately: 37% from homes (including farms); 30% from industrial power (including railroad electrification); 28% from stores, hotels and small power (what we call "commercial" business); and the remaining 5% from municipalities, mostly for lighting streets.

The relationships as to sources of income are incomplete without a corresponding statement as to where the money goes in the electric utility business, and with respect to this the averages show the following for the industry as a whole:

DISTRIBUTION OF REVENUE IN 1937
(Total approximately $2,055,000,000)

Power (Fuel alone 8.4%)	13.0%	
Transmission and Distribution	8.2%	
Commercial and New Business	9.0%	
General Expenses	7.5%	
Total Operating & Maintenance		37.7%
Taxes	16.1%	
Depreciation	10.5%	
Balance for Return on Investment	35.7%	
Total Fixed Charges		62.3%
		100.0%

These relationships show that power production alone (exclusive of fixed charges) amounts to but 13% of total costs, that all operating expenses, including power, aggregate but 37.7%, that relatively fixed charges amount to 62.3% and that the balance for return on investment (in 1937 $735,000,000) was but 5.9% on the $12,500,000,000 invested in the industry. Further breakdown, not shown in the foregoing table, indicates that payroll comprises 55% of all operating expenses, or 21% of total costs. Another interesting side-light is that in the case of purely hydroelectric power, sold wholesale, 92% of the cost consists of charges relatively fixed in nature (taxes, depreciation and return on capital) and only the small balance of 8% represents operating expenses.

The purpose of my paper is to show what these relationships mean as to the true weight and economic importance of the electric utility industry in our national economy and the conclusions which would appear to follow therefrom.

So far we have considered only conditions within the industry. Let us now observe how these affect the consumers of the electricity which the industry produces. Let us take first the residence consumer (including farms), which represents not only the largest single category as to revenue (37%) but also the overwhelming preponderance in number of customers. He constituted last year over 84% of all the electric customers—about 23 million out of 27.2 million total.

The residence customer in 1937 paid an average bill of $34.81 for the year, at an average rate of 4.39c. per kilowatt hour. On account of requiring a relatively large amount of distribution and overhead cost, due to his small average size, the cost of the raw energy he used (including therein fixed charges on generating plant) was comparatively small. It averaged for the whole industry only about one-seventh of what he paid for his relatively small consumption. So that if someone had furnished the raw electric energy for nothing, it could have had but little effect on the total cost of serving him.

The foregoing represents the condition encountered so often in our national economy, where the original value of the raw material in a small package of any commodity is a very small percentage of the retail cost of the package in question. I have mentioned it now in order to return to it when considering Government power policy later in my paper.

Another measure that should be applied to the cost of electricity in the home is what proportion it bears to the total family budget. It is difficult to get a thoroughly satisfactory figure for the average wage-earner's family budget, but the most competent studies indicate that about 2% of it represents the cost of electricity in the average homes. According to the National Industrial Conference Board, based on many years' continuous study of the average cost of living, the principal items of home budgets in order of size are:

Food	33%
Sundries	30%
Housing	20%
Clothing	12%
Fuel and Gas	3%*
Electricity	2%*
	100%

*The Conference Board brackets these two.

It will be observed that Sundries amount to 15 times as much as Electricity in the family budget, and a study of

some of the items in the sundry category fully bears this out. For example: the people pay as much for candy or ice cream as for electricity in the home and even more for cigarettes; drug stores take in twice what the electric companies do for home service; filling stations three times as much and automobiles eight times as much.

I should be the last person to belittle the great social value of electricity in the home, where it means so much in comfort, safety, convenience, and in the saving of drudgery patiently borne for ages before this tireless servant was summoned to the aid of mankind by the engineers; but the figures I have given must show conclusively that the economic burden of electricity is of the smallest.

Let us next consider briefly the second largest category of earnings from the sale of electricity, namely that used in industry. This group, while accounting for 30% of the earnings of the electric utilities, represents over half of the energy sold and less than 1% of the consumers. This industrial business carries a lower rate than in the home, because it is sold in wholesale lots and is thus cheaper per unit to distribute. This part of the electric business is also strictly competitive with what each customer could do for himself in producing his own power; in the household, on the other hand, only about two-thirds of the energy consumed is competitive (with the ice-man, the gas-man or hard labor), the balance being relatively necessitous lighting.

The great value of electric power in industry arises from its economy, dependability, uniformity and applicability to specific machines. The great increase in the mechanical aids to labor in American industry during recent decades has developed largely from the use of electricity for power. In the three decades ending 1929 the horsepower per employee in American factories rose from 1.9 to 4.9, thus representing a vast extension in effectiveness of human labor and a corresponding gain in productivity and earning power per worker. In fact, it has frequently been observed that the application of mechanical power to industry has been the very basis of our growth in national earning power and of the economies of mass production. Yet even here the great economic gain to the nation has come from what electricity *does* rather than from the relative amount it *costs*.

In the year of our greatest industrial production (1929), when the value of manufactures in this country aggregated approximately 70 billion dollars, the cost of power (only about half of which was purchased), based on the average for industry, was but 1.88% of the total value of product. When we compare this with over 32% of the total for raw materials, 34% of the total for wages and salaries and 21% for miscellaneous expenses, it becomes clear that, measured by the cost of the service, power is a comparatively trifling item. It is a curious coincidence that, in the case either of the household budget or of the industrial budget, the cost of electricity amounts in each case to only about 2% of the total.

In view of the facts and figures I have recited above (all of which are based on dependable statistical sources which can be readily checked), it must sometimes seem incomprehensible to the detached observer that the Federal Government should display such a feverish solicitude for the power costs of the nation as to appropriate $2,425,000,000 for water power or other electric development, which in many cases is not needed, in most cases involves a large subsidy from the taxpayers and is expended at a time when our national budget is heavily unbalanced. When we compare the total tax burden of the country with the cost of electricity in the home, it would seem pertinent to inquire if the instrumentality that imposes these taxes could not be of more help to the citizen through lightening the tax load than through spending his money in such vast sums on such a relatively trifling part of his budget.

Total Government expenses in 1936, Federal, State and local, were $17,047,000,000. Estimating population in that year at 128,430,000 and taking the U. S. Census average of four per family, these Governmental expenditures thus amount to $531 per family. In the same year the average residence bill for electricity was $33.81, so that a 6.4 per cent reduction in Governmental expenditures would be equivalent to wiping out the entire electric bill in the home.

There is another angle to the matter of Government development which those unfamiliar with the electric business naturally fail to appreciate. This arises out of the disproportionate amount of capital required for utility service compared to general industrial business. The whole Government power program boils down in essence to taxing all the people in order to make cheaper power for special groups of people in special localities. Or, regarded in another light, it is taking money from all the people as taxpayers in order to help out special groups as consumers. It is at least debatable whether this is wise public policy, but let us assume for the sake of discussion that it is wise and proper and praiseworthy. That still leaves open the question of whether it is the most practical thing to do economically.

The long record of the electric utility industry shows that about $6 of plant investment is required to produce $1 of annual gross earnings. The Census figures on the subject (1919) show that for industry as a whole in the United States there is required but 71c of plant investment per dollar of annual gross sales. With greater mechanization this figure may be somewhat higher today. The Government, therefore, in going into the power business as a form of largesse, is choosing the one that takes the maximum of capital. The Government raises its capital in the end only from taxation, so that it can produce less saving for the consumer per dollar taken from him as a taxpayer through the electric power route than through almost any other. It would save the people much more money, net, to make the donation in the form of candy, cigarettes and other similar items, each of which bulks about as big as electricity but would require only a small fraction of as much capital to produce.

There is another practical economic aspect of this matter (assuming always that the largesse is sound) which arises from the analysis I have already given of the costs of furnishing electric service to the people. You will recall that I showed earlier that, of the total cost of delivering all electric service, the raw power, that is the electricity itself, amounted to but 13 per cent of such total, or, including the share of fixed charges attaching to it, about 26 per cent. For the residence consumer alone this ratio is about 15 per cent. Thus, if Government power were given away free (as a pure gift from one group of taxpayers to another) it could not save the home owner over 0.3 per cent of the family budget, and if sold at one-half present average wholesale rates would save but 0.15 per cent of the family budget.

Such a drastic cut in rates would of course prove ruinous to the private utilities (which still furnish 93 per cent of the country's electricity) and the threat of it has already produced staggering losses in security values to the millions of investors who have contributed the 12½ billions of capital to this business, which is largely under Government regulation. It is this disproportionate injury to millions in order to produce the comparatively trifling benefit just mentioned which makes the process appear to the owners and operators of privately-owned public utilities as another example of the classical case of "burning down the barn to get a mess of roast pork."

From a practical economic standpoint of help to the consumer, therefore, Government power development finds itself trying to help the people in probably the least efficient way per dollar spent for the purpose that it could choose.

I have endeavored to confine my presentation to purely general economic grounds; but there is one especial feature of the Government power program, which, due to the publicity it has received, I ought not to omit from my discussion. I refer to the so-called "yardstick" which it has been alleged Government operation should furnish for measuring the efficiency and economy of private operation. For, having, as I believe, demonstrated that the prominence of the electricity question is not justified on economic grounds, it must rest principally on its publicity features.

Using the word in its metaphorical sense, as is done in applying it to electric rates, "yardsticks" are a necessary tool for any properly operated business, particularly one like the electric utility business, where the same general procedure is followed in so many cases. We usually refer to such a tool in business by the dignified title of "comparative statistics," but it means the same thing metaphorically in common parlance as yardstick, foot rule or any other measuring device. The difference between the ordinary yardstick and the Government power yardstick is that the former is used for measuring one simple thing, to wit, length; while the power yardstick on the other hand attempts to measure comparative costs in the power business, which are complex in their nature.

Rates for electricity are, and have been for years, almost universally regulated by State Commissions. They are fixed, not to produce any profit, but to pay only for the cost of rendering the service—that cost including operating and maintenance expense, taxes, depreciation and a return on the investment sufficient to attract capital to the business. I have shown earlier the relative size of each of these items. The utilities have no source of income except from the rates paid, so that unless the rates are sufficient to pay the costs, either bankruptcy or inadequate service results. I have shown also that for the average utility five-eighths of its cost are relatively fixed charges, like taxes, depreciation and return on investment. These being facts, it should seem clear that no yardstick or any other measuring device could be an accurate measure if it did not duplicate the condition to be measured.

To take a few examples at random: fixed charges with private utilities in the case of hydroelectric plants selling wholesale, amount to 92 per cent of the total, these fixed charges consisting of taxes, depreciation and cost of capital; yet we find the T. V. A. allocating only 52 per cent of its investment to power, charging no depreciation, and for taxes about one-third what similar wholesaling private utilities average to pay. I am not attempting at this time to discuss the wisdom or accuracy of such accounting but common sense forces the conclusion that the results so obtained could not be any accurate yardstick or other measure of what should be the costs of a private company which has to pay charges on 100 per cent of its investment and full taxes and depreciation. In the case of the Bonneville development on the Columbia River, only 22 per cent of the initial investment is charged against power, the remainder being carried by the taxpayers. The great difference between the 52 per cent in T. V. A. and 22 per cent in Bonneville does not concern me in this discussion: my contention is that neither is an accurate measure of what anyone else could show without such subsidy from the taxpayer.

Another familiar example is the donations by P. W. A. and W. P. A., aggregating $150,000,000, that have been made to cities to build electric plants to compete with their local utilities. These donations have been 45 per cent of the cost of the plant and are, of course, tax-exempt. Tax-exemption plus 45 per cent of the charges on plant, as shown by my earlier table, amount to 36.8 per cent of the total costs of the average utility. The "yardstick" resulting from these donations of taxpayers' money is thus 22¾ inches long.

My very closeness to the electric utility field, in which I have been working for 35 years, naturally makes me a prejudiced witness in passing on the policy of my Government in attacking my industry; but my long familiarity with every phase of the business does entitle me to speak with authority on the economics involved and I have tried to confine myself to this aspect of the subject.

The realm of electricity is so broad that it is difficult to confine it to the limits of a brief paper like this, but if I might summarize what I have tried to demonstrate, I should say:

1 That the economic value of electricity to the people (in greater ease, comfort, safety and efficiency) is much greater than its economic cost to them, and

2 That the cost to the taxpayer of the huge Government power subsidies is much greater than their economic value to the country.

Paper Pays Tribute to Couch's Service in the Industry

THE *Arkansas Gazette,* largest newspaper in the state and the oldest west of the Mississippi River, issued a large special section of its paper on Sunday, June 26, devoted to paying tribute to Harvey Couch's 25 years in the electric power industry.

Articles by staff members on the brilliant career of Mr. Couch from his boyhood on a farm to his rise to the presidency of the Arkansas Power and Light Company, and on the history of his company, were featured on the front page with a picture of Mr. Couch and a picture of his first plant, operated by steam from a sawmill.

Featured and particularly interesting in the section were articles on the heads and histories of the eight divisions of the company. Through these the names of the 1,056 employees working in the 56 counties served by the company were published. It was the first time that a special section of any paper in this state ever devoted space to listing the names of all employees.

Many firms and individuals used ads in the section to congratulate Mr. Couch on his part in "Helping Build Arkansas," the slogan he has used since his start in the industry.

Radio Frequencies Available to Public Utilities for Emergency Work

At the informal hearing of the Federal Communication Commission, held in June, 1936, a committee* of the Institute presented briefs on behalf of the electric light and power companies for the allocation of radio frequencies for emergency use. In these briefs** the committee pointed out the need of the electric utilities for point-to-point communication where all forms of wire communication had failed, and also for communication between the trouble dispatcher and trucks and service cars in cases of emergency.

For the point-to-point communication it was pointed out that the radio would be used as an auxiliary to the normal wire communication service where the wire communication had failed, or where there was a serious curtailment of such facilities. In the mobile service the radio would prove of great value in trouble dispatching in all cases that involved hazard to life, property, or public safety. In this connection it was pointed out that the availability of this service for immediate communication between dispatcher and trouble cars would be of great benefit in case of major system disturbances, cases of wires or lines down, broken poles, interruption of primary circuits, interruptions to essential public services, interruptions to a large number of customers, particularly where street lights or traffic lights were involved, interruptions to h o s p i t a l s, schools, theaters, large factories, large department stores, or other places of public service. In Order 19, relating to allocation of frequencies between 30,000 and 300,000 kc, the Commission recognized this need of the utilities and tentatively allocated certain frequencies for special emergency services. On June 22, 1938, the Commission made final the section of this order, as amended, for frequencies between 30,000 and 60,000 kc. At this time the Commission also issued rules governing the use of these frequencies. The complete rules governing emergency service have been sent to all member companies of the Institute and additional copies are available through the general office of the Institute. The following gives the rules which relate to the frequencies available and the limitations under which they can be used:

Section 111.27 requires cooperation between various organizations in a given territory in the use of special emergency frequencies. This section reads: "No frequency available to a station in the emergency service will be assigned exclusively to any applicant. All stations in this service are required to coordinate operation so as to avoid interference and make the most effective use of the frequencies assigned." We have been informally advised that the Commission desires that contact be made between the various utilities in a given territory to discuss the coordination of the use of these frequencies before the application is made and that the application show that this coordination has been carried out.

Section 110.07 defining "special emergency station" reads: "The term 'special emergency station' means a station used for communications in emergencies in lieu of normal means of communication."

Section 111.03 defines those eligible for special emergency station licenses as "Authorizations for special emergency stations will be issued only to (a) organizations established for relief purposes in emergencies and which have a disaster communication p l a n ; (b) to persons having establishments in remote locations which cannot be reached by other means of communication; (c) to public utilities."

Section 111.25 reads: "The following frequencies are allocated to special emergency stations:

(a) For portable-mobile stations:
31,740 kc 33,060 kc 33,820 kc 35,140 kc
37,180 kc 37,820 kc 39,340 kc

(b) For fixed and land stations without limitation as to power:
31,420 kc 39,660 kc 39,860 kc

(c) For fixed and land stations with a maximum power of 1000 watts:
2726 kc (A-3 emission)
3190 kc (A-1 emission).

"Notwithstanding the provisions of (b) and (c) of this Section, authorizations may be issued covering the operation of mobile and portable-mobile stations on the frequency, or frequencies, assigned to licensees of fixed or land stations."

Section 112.06 reads in part: "Municipal police stations, although licensed primarily for communication with mobile police units, may transmit emergency messages to other mobile units such as fire department vehicles, private ambulances and repair units of public utilities, in those cases which require cooperation or coordination with police activities."

Section 117.01, providing for the scope of special emergency service, reads: "Special emergency stations may be used only during an emergency jeopardizing life, property, public safety, or for essential public service, or when such an emergency is imminent, for communications relating thereto and for other essential communications. They may be used (a) for transmission from one point to another between which normal communication facilities are not usable, or are temporarily inadequate, or (b) for transmission to or from mobile units."

Section 117.03 provides for testing. It reads: "Special emergency stations may also conduct routine tests not exceeding two minutes in each half hour, or where more extended tests are required, they may not exceed a total of four hours per week."

The committee believes that this allocation of frequencies and these regulations provide for reasonably complete use of radio by public utilities in connection with emergency service. One company has already installed a station for communication between dispatcher and mobile units for this service, under an experimental license. About a dozen stations have been in operation for point-to-point service on a frequency of 2726 kc over the past several years. At the present time about a score of companies have applications on file with the Commission or in preparation. It is the belief of the committee that the frequencies now available will fulfill the immediate requirements of the electric utilities and that additional frequencies will be allocated to this service when the remainder of the spectrum is made available, providing full use is made of the frequencies now allocated.

*—H. W. Eales, Chairman.....Chicago, Ill.
P. H. Chase.....Philadelphia, Pa.
J. O'R. Coleman.....New York City
E. D. Glatzel.....Detroit, Mich.
Alexander Maxwell.....New York City
G. W. Spaulding.....Baltimore, Md.
Philip Sporn.....New York City
G. H. Underhill.....Poughkeepsie, N. Y.

**Brief published in E.E.I. Bulletin, August, 1936, p. 347.

Electric Utility Problems

By H. C. Thuerk

The Utility Management Corp., New York, N. Y.

An address before annual meeting of the New York State Association of Electrical Contractors and Dealers, Big Moose, N. Y., June 20-22

I HAVE been asked to discuss with you today some of the problems facing the electric light and power companies. I am not unaware of the fact that most people dislike having to listen to the other fellow's difficulties. However, the fact that there are present at this convention electrical contractors and dealers, wholesalers and distributors, as well as representatives from manufacturers of electrical equipment, and electric light and power companies, lends me assurance that perhaps each of us has some real interest in the other fellow's problems.

As a background for discussing some of these problems I would like first of all to review for you the development of the electric power industry and the participation in this development by our customers, our employees and the electrical trade.

This industry, which has been in existence for but little more than half a century, today provides most of the power used in our factories and stores, as well as makes possible indispensable convenience through the performance of innumerable tasks in 23,000,000 American homes. To obtain some idea of the rapid extension of the use of electricity let us remember that in 1907 the total number of customers was about 2,000,000. By 1927 this total had risen to over 21,000,000 and at present is approximately 27,000,000. In 1909 the industry was supplying but 9 per cent of all the power used in our manufacturing establishments. By 1929 it was furnishing over 50 per cent of the power, and today that percentage has probably grown to a materially larger figure.

Now let us see in this period what benefits have accrued to the American public. Electric service has been made available in a relatively short space of time to a large proportion of American homes, factories and stores. Not only has the economy and convenience of electricity been brought to increasing numbers of customers but, at the same time, the cost of the service has been decreased materially. Since 1913 the average residential rate has dropped from 8.7c. to 4.5c. per kilowatt-hour, a reduction of nearly 50 per cent. This was accomplished in spite of the fact that the cost of living is today 50 per cent higher than in 1913. In like manner the cost of electricity for factories and store service has shown a marked decrease. Since 1927 the average rate to these classes of customers has decreased approximately 21 per cent.

The private electric power industry today has an investment of approximately $12,000,000,000, with an annual income from the sale of its services of approximately $2,000,000,000. This investment with the materials necessary to maintain the physical equipment represented by it, has provided the means of livelihood to a large section of our population, not actually engaged in the operation of our power companies. Interest and dividends on utility securities have contributed substantially to the welfare of the American people by providing aid to commerce and employment and to finance additional enterprise which in turn provides the means of additional employment.

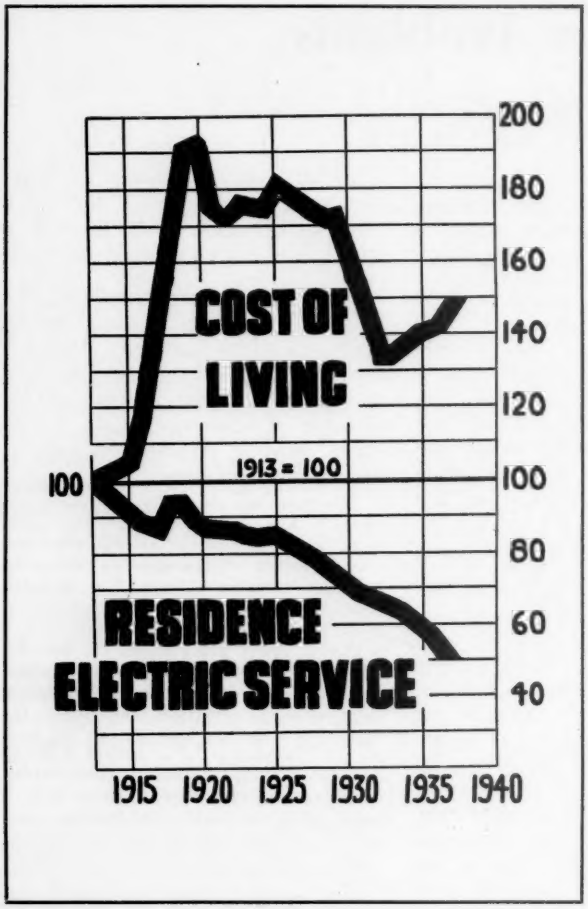
The electric utility industry, through its payment of heavy taxes, contributes materially to the support of local, State and Federal governments, including the school and educational systems financed through tax levies. The utilities have been returning in the form of tax payments an increasing proportion of the revenue dollar until today approximately 16c. out of every dollar of gross revenue is paid out for this purpose. I think you will be interested in the fact that in 1937 for the first time in the history of the industry, tax payments have exceeded the entire interest requirements on the $6,500,000,000 of outstanding power company bonds.

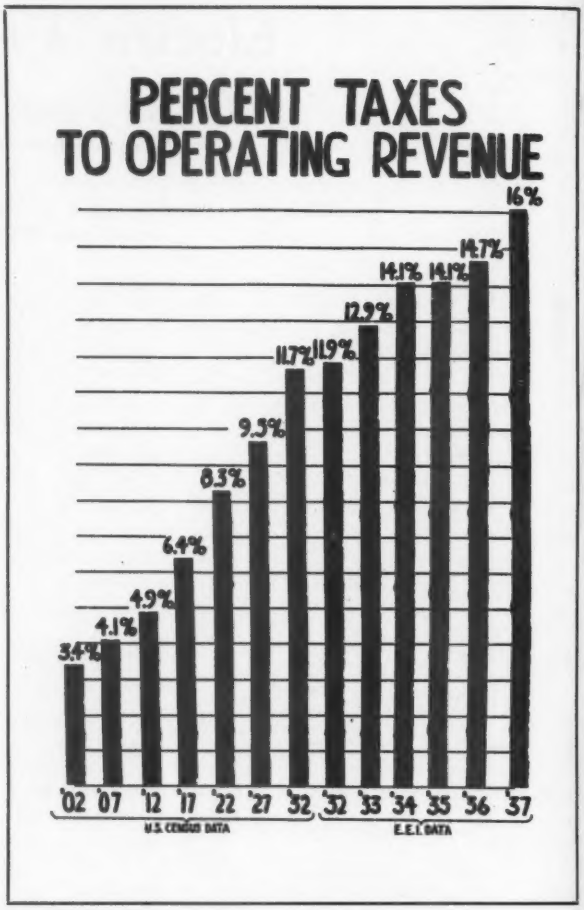
Perhaps the best way to sum up the benefits which our American people have obtained from the remarkable development of the utility industry is to read to you a statement made by Mr. W. C. Mullendore, of the Southern California Edison Company. In a talk given before one of the group meetings at the 26th Annual Meeting of the Chamber of Commerce of the United States, held in Washington recently, Mr. Mullendore stated:

> "Not only has electricity contributed directly to better living and working conditions, but it is also the agency which has made possible refinements in industrial processes, bringing a great line of better products to the public. Mass production is made possible by the assembly line—and it is electric power which makes the assembly line possible. Our automobiles are stronger, faster and safer through the use of special steels made by electrical processes. The clothes we wear, the food we eat, yes, even the air we breathe in a modern building, depend upon the application of electricity.
>
> "We get our information about what is going on in the world with amazing speed because of electrical devices — telegraph, linotype, high speed presses, stock tickers, radio.
>
> "The foregoing facts are well known. There is little dispute about them. It is now generally admitted that in the short space of a quarter century these enormous strides have been made in the utilization of electricity, in putting it to work, in making it the indispensable servant of mankind which it is today."

Not only have our customers and the remainder of the American public benefited materially from the development of the electric utility industry but our employees as well, we believe, have participated. In addition to our customers and our employees, there is another group that has a definite interest in the utility industry. I am referring to the electrical contractors and dealers, the wholesalers and distributors and the electrical manufacturers. Electricity to perform its tasks must of course be utilized through an appliance or a piece of equipment. The business of supplying and installing these appliances and equipment to our customers has become one of the largest enterprises in the country. Let's see just how big it is.

According to data available from *Electrical Merchandising* and the Edison Electric Institute, the total volume





of retail sales of domestic and commercial appliances, industrial apparatus, insulated wires and cables and miscellaneous electrical construction apparatus was approximately $1,922,000,000 for the year 1937. If to this total we add the volume of sales of lighting equipment, the grand total in all probability would be close to $2,200,000,000. The sales volume of domestic and commercial appliances has increased from approximately $600,000,000 in 1932 to approximately $1,500,000,000 in 1937, or in other words the sales volume in 1937 was two and one-half times that in 1932. These figures cover only the sales of appliances and equipment and do not include installation costs. When installation costs, which include miscellaneous equipment and labor, are added to these figures, the total business done by the electrical trade is increased materially. It is interesting to observe that in 1932, 80.8 per cent of the sales of domestic appliances, exclusive of radios, were made by retail outlets other than the utility companies and that by 1937 this percentage had increased to approximately 85 per cent.

This volume of business represents a remarkable accomplishment and has been brought about through the combined efforts of all branches of the electrical trade. As we all realize, the market for the sale of additional electric appliances and lighting equipment is still far from the saturation point. There awaits consequently a huge untapped reservoir of potential business, the availability of which is dependent to a large extent on a marked increase in the national income.

If we could raise the existing levels of lighting to the present standards of 25 foot-candles for reading and 10 foot-candles for general illumination in the home, 20 foot-candles to 50 foot-candles for commercial establishments, 10 foot-candles to 100 foot-candles for industrial plants, with an average of about 20 foot-candles, it would require the following expenditures for fixtures and wiring:

Residential fixtures	$600,000,000
Commercial fixtures	150,000,000
Industrial fixtures	50,000,000
Wiring	280,000,000
Total	$1,080,000,000

Here I would like to say just a word regarding a subject which for many years has been much debated and frequently has resulted in unfortunate relationships between electrical dealers and the electric companies. I refer to the question as to whether the electric company should be in the merchandising business. Unlike a problem in arithmetic, this question undoubtedly has several satisfactory answers. I believe that a satisfactory answer can be reached only by consideration of the question on a local basis and then only after all parties have carefully considered all of the advantages and disadvantages of the proposed plan. What might be an excellent arrangement for all agencies in one location might not be satisfactory at all in another.

In working out a solution to this question in any locality I believe a great

deal will be gained if a certain common fallacy is disposed of before the plan is developed. The fallacy I refer to is the one that all of you these days have come up against so often. It is the fallacy of thinking that "there is just so much to go around." I can recall a statement made to me by a young man who was criticizing what he considered high salaries of executives in business. He stated he did not believe they should be paid so much because by paying them so much there was that much less money to be paid to all the rest of the workers. We know this is a fallacy when we realize that the national income in this country in 1932 was $46,500,000,000, whereas in 1936 it was $64,000,000,000, and estimated to be $67,500,000,000 in 1937.

These figures indicate that there is not "just so much to go around." If through the incentive of comparatively high compensation, executives are able to develop production and sales ideas which result in increasing the national income, then everyone benefits.

The same thing holds true in the sale of merchandise and appliances and I have only to refer you to the figures I quoted before and which indicate changes from year to year in the volume of appliances sold. And so it seems to me that when a dealer has the impression that if the utility will go out of the merchandising business it will be insurance to him that he will obtain more business, he has either been misled by people who are interested in promoting ill-will in the electrical trade or else there has not been available to him sufficient sound information upon which a logical conclusion could be reached.

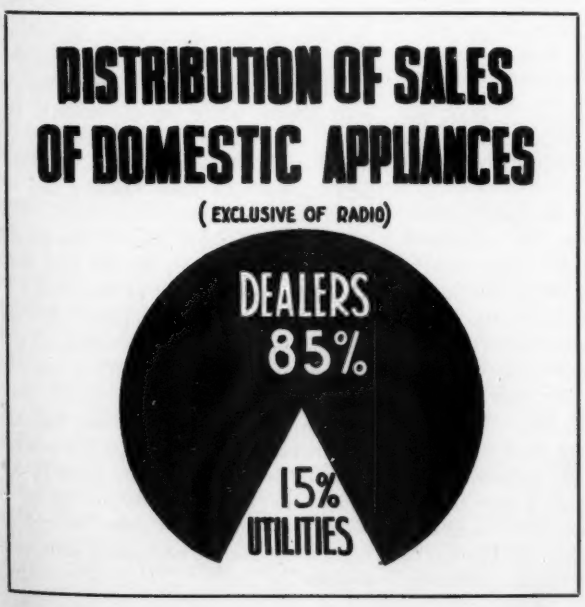
In spite of the remarkable development of and the benefits derived from the utility business, this industry faces today some very serious problems. In 1937, from a gross revenue of $2,055,000,000, the electric light and power companies, as reported by the Edison Electric Institute, had an operating income, after depreciation but before interest payments, of $727,000,000. So far this year these companies have shown a decrease in operating income of about 10 per cent, indicating for the year 1938 an operating income of about $654,000,000. The U. S. Census of 1927 shows for that year an operating income from electric operations of $646,000,000. The income of the electric light and power industry available for the payment of interest and dividends is thus practically back to where it was eleven years ago, although in the meantime nearly $5,000,000,000 has been invested in additional plant and equipment.

This means that the former proportion of gross revenue is no longer being translated into net income and raises the question as to whether the industry is approaching the point where increases in business are unlikely to produce sufficient revenue to carry the additional necessary investment. This is a serious situation, particularly when it is realized that unlike most businesses which are able to turn over their capital at least once each year and in most cases even more often than that, the electric utility business turns its capital over but once in from five to seven years.

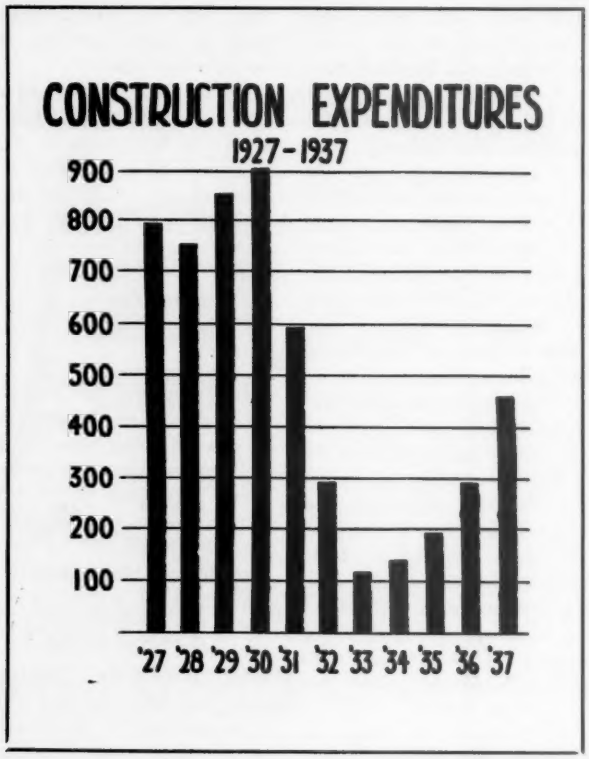
Up to 1933 the ratio of net to gross was fairly satisfactory, but since 1933 when the first upward surge of costs took place there has been a marked reversal in the relation of the amount of business done and the profits arising from doing this business. In this same period, while operating expenses and taxes were mounting the industry has had to absorb almost continual rate reductions.

Last summer, the American Business curve apparently became fatigued from an upward climb from the dark days of 1932 and proceeded to come down at an almost precipitous rate. The net effect of this descent brought the Federal Reserve Board's Index of Industrial Production from 118 in August, 1937, to 77 in April, 1938, and in all probability the Index was even lower in May. Gross revenues of the industry reflected this drop in industrial production so that today we face not only the problem of a marked decline in the rate of return on investment required for new business, but also the problem of a trend toward decreasing volume of our present business.

Since 1933 the industry has been faced with another problem which is of more serious consequence than most people believe. In this period the industry has been subjected to continuous threats of possible destruction through subsidized competition from funds obtained from the Federal government.



POTENTIAL MARKETS FOR
Lighting Fixtures & Wiring
RESIDENTIAL FIXTURES – $600,000,000
COMMERCIAL FIXTURES – 150,000,000
INDUSTRIAL FIXTURES – 50,000,000
WIRING – – – – 280,000,000
TOTAL – $1,080,000,000



That this type of governmental competition is to continue is evident from the action taken by Congress on the recently enacted Relief Bill. Loans and grants from the Public Works Administration have been made available to Federal, State and Municipal political subdivisions to build competing electric light systems. Outright grants of 30 per cent and 45 per cent have been made, thereby subsidizing certain public plants and encouraging them through this policy to charge, temporarily, rates which will tend to drive the private utility from the field.

Rubber yardsticks of rates have been set up by various governmental agencies which have been used as clubs to force the private companies to reduce rates. That these yardstick rates are based on incomplete costs is quite evident when it is realized that the rates established for wholesale power for the Bonneville power project in Oregon are approximately half of those now being charged for similar service by the thirty-year-old Hydro-Electric Power Commission of Ontario.

Here is what the New York *Times* had to say about these rates in an editorial published May 30, 1938:

"As if the projection and completion of Government hydro-electric plants were not enough to undermine confidence in privately owned utilities, J. D. Ross, Administrator of the Bonneville project on the Columbia River, has filed a schedule of rates which dwarf even those fixed by Ontario for Niagara Falls power. What is called "prime power" from the Bonneville general transmission system is to be sold at $17.50 a kilowatt-year; the corresponding rate for Niagara is $34.80. For electricity sold directly at the plant the proposed Bonneville rate is $14.50 a kilowatt-year; at Niagara the equivalent rate is $25.33. Apparently, Niagara rate history has been ignored. Ontario found it necessary almost to double its early charges. In 1918 the wholesale rate at Toronto was only $18.91 a kilowatt-year, and five years earlier electricity could be bought at the Niagara Power House itself for only $13.20 a kilowatt-year. In other words, the Bonneville rates are to be lower than those which Ontario found to be utterly without economic justification."

The combination of increased operating expenses and taxes and subsidized government competition have brought about a sit-down strike in the utility capital market. As a result the utility companies in 1935 and 1936 were able to obtain only 15 per cent of their construction funds from new capital issues. This compares with 97 per cent of total construction funds from these sources in the years 1925 to 1930, inclusive.

It is not surprising then that the industry finds itself with few exceptions forced into the position of having to apply the brakes. To keep to a minimum the need for additional construction for which funds are not available, sales organizations have been curtailed, advertising and promotion plans have been contracted and a Herculean effort made to control as much as possible the upward trend in operating expenses. All of this affects materially the business of all members of the electrical trade.

These are some of the problems which the electric utilities are most concerned about at the present time. The ultimate solution of problems of this nature which are to some degree affected by political influences, lies with the American public. If our customers can be given all the facts about our industry and its contribution to the improvement in the standard of living of the American citizen, then eventually public opinion will demand the removal of the barriers which now obstruct its further expansion and development.

There is evidence at hand which indicates that the American citizen is already beginning to realize that his best interests will be served by relying on private companies to furnish him with electricity. This is shown in the outcome of local elections in 540 communities having a total population of 22,638,000 which voted during the past five years on questions involving municipal ownership of electric plants. The per cent of the population in communities favoring public ownership fell from 70.5 per cent in 1933 to 11.5 per cent in 1937.

Many of you, I am sure, are familiar with Aesop's fable about the belly and the members. You will recall that the members of the body rebelled against the belly and said, "Why should we be perpetually engaged in administering to your wants, while you do nothing but take your rest and enjoy yourself in luxury and self-indulgence?" The members carried out their resolve, and refused their assistance to the belly. The whole body quickly became debilitated and the hands, feet, mouth and eyes, when too late, repented of their folly.

We in the electrical industry, the contractors and dealers, the wholesalers and distributors, the manufacturers and the utilities are pretty much in the same position. If we can all work together in a cooperative and constructive manner it would seem logical that through our efforts the way could be paved for a return to conditions under which all branches of the industry could grow and prosper.

Does the Industrial Power Plant Pay?

By Page E. Golsan, Jr.
New York State Electric & Gas Corporation

NOT long ago I had an interesting talk with an old friend of mine who puts his ideas in a homely sort of way and his experience in a power deal is worth re-telling.

When he took over the management of a sizable manufacturing business some years ago, they were making power with old-fashioned engines and costs were high. He was forced either to build a new plant or to purchase his power. A careful study showed—on paper—that he could build his power plant and get an apparent return of 9 per cent on the investment as compared with purchasing from the local utility. Did he build? He did not; he purchased. Not long after that he sold the business. The stock market crash came in a year or so and the new owners had to shut down for awhile. If he had built that power plant, the fixed charges on it during the depression would have put the business in bankruptcy.

Mind you he made this decision when times were good and money easy to get, so I asked him what reasoning he used to arrive at such a sound decision. He replied that the job of deciding whether to buy power or to build a plant should look further into the proposition than mere figures on paper. Good old-fashioned horse-sense ought to be added. As he put it, "You have to live with a power plant for some time if you build it. The idea is to find out first whether it will ever show up in the red no matter how good it looks on paper today. Maybe in a few years the cash in the bank will save your business and so be really worth many times its face value. Or maybe you ought to modernize instead. Or possibly you can turnover the cash a half dozen times every year and make more money. Would you do better to concentrate your management efforts on your own business and let the power fellows make power? If some day we have inflation or at least higher prices, what about fuel costs and hoped-for savings? And most important of all: Don't short change yourself on depreciation. This is so often done and then found out about too late. Give all these a good turn in your mind—then decide what you want to do."

All of this sounds like good common sense.

The Cash May Save Your Business

The man who has ever worried about meeting a payroll on Saturday noon knows how much cash is worth. And the poor fellow who was forced in 1932 to sell his General Motors stock at 8, to meet a mortgage payment, knows what cash on hand can do. It is the life-blood of a business and to turn it into the bricks and mortar of a power plant (an expenditure that is not necessary if power can be purchased) is not something lightly to be done—unless money is no object.

As Poor Richard's Almanac said, "If you would know the value of cash try to borrow some of it." Time and again Dun and Bradstreet has pointed out in its Review that the chief reason for business failure is too much capital tied up in fixed assets leaving not enough for working capital.

The old story of the grocer who spent so much money on his fancy cash register that he couldn't carry his credit customers applies just as well to any business: power plants or horse shoes. And everyone knows that the first lesson in the book of management emphasizes the value of cash to weather hard times.

But what is of more importance to the up and coming business man is the fact that he will need more working capital to operate his company as it expands. To do more business, inventory must be enlarged; accounts receivable will also increase and so it goes. Judging from past business cycles just when business is best and money most needed, interest rates rise and it is difficult to borrow. Perhaps such a squeeze won't happen again but there is one sure way of building up an enterprise and still staying in business, and that way is to be safe—to keep cash on hand and be solvent, come what may.

The 1936 Revenue Act Makes Cash Even More Valuable

The excessive tax on undistributed profits running up to more than 50 per cent makes it more than ever necessary to conserve one's working capital. It is too expensive to withhold much from dividends.

If you decide to pay an undistributed profits tax in order to keep cash and then turn right around and spend money on a new power plant, you *increase the cost* of that plant by the *rate* of the *tax*. So when you figure the profits, increase the estimate for the plant investment by that much.

Modernize First

You know better than I that ever changing conditions of markets and products make it necessary for a manufacturing or commercial concern to keep equipment up to the minute; styles and products are always changing. The company with ample cash can readily adapt itself to these changes and is in a superior competitive position for the trend today is to use cheaper ways of getting low costs—to avoid heavy investment—to keep flexible and so be ready to move along with changes as they come. There is only one way to compete under such conditions: keep up-to-date. Ever to drop behind may so ruin the earning ability that it may become impossible to catch up. Therefore modernize the process in every respect before thinking of diverting a dollar into a power plant. Cheap power has never yet put an obsolete plant back on its feet.

Make More on Turnover

Yes—that word turnover comes up whenever management is being discussed. I am not speaking about stores and mercantile lines—where turnover is all important. I referred to manufacturing plants where effort is made to increase turnover by production control, by modern machines and better methods. A man's qualifications as a manager are often gauged by the times he turns over current assets each year.

It is not unusual for a concern to make from 2 per cent to 10 per cent profit on each turnover and the more turnovers possible per year, the greater the annual profits. Five turnovers of 3 per cent each yields 15 per cent for the year. Ten turnovers is 30 per cent per year. Such figures are not extraordinary, for some concerns on their toes show annual returns from turnover up to 100

per cent. But compare this with the meager 8 per cent or 10 per cent per year that might (I say "might" for reasons that you shall see later) accrue from a power plant investment.

An industrial company in our district a few years ago built a power plant. The manager tells me today he is sorry he did so because conditions have changed. Not only have fuel costs gone up but, more important, his business has grown and if he had the cash to put into more accounts receivable, he knows he could make more money. As it is, he has limited his working capital.

Working capital and management after all make the profits. Equipment is but the tool which is used in the job. Now here is the point: the power plant is *not even a tool* for making industrial profits out of working capital. Why? For two reasons—first, it does not directly make the product that is sold. Second, it could be dispensed with if power were purchased and for that reason it should be viewed merely as any other outside investment. These are important questions to answer: Can we spare the money for such an outside investment? Will the money earn more in the business? If the cash is needed later, can we get it back? No—not out of a power plant.

Does It Pay to Spread Management Too Thin?

Certainly it seems in these days that about 100 per cent of a manager's attention to his business is needed to make a decent profit. Sometimes it almost seems that more than 100 per cent is needed. What with taxes, labor, keeping up with competition, new products, finances one has to spread out pretty thin and the more I see of things, the more I am convinced that one ought to stick to his own line if he hopes to make a profit and to stay in business.

A power plant is one more thing to worry about. Place yourself in an important meeting with your best customer. By using every effort you have a contract for a year's business ready for signature. At the critical moment your assistant, Joe, phones and says that the feed water pumps in the generating station have gone out and the entire plant is down. Joe wants to know what to do. Your conference is derailed and if the sale is lost you may wish you never heard of a power plant.

Perhaps this illustration seems too pointed, but it actually happened. Generators do burn out, fuel prices must be watched, cost figures must be prepared by the accounting department and reviewed. The costs of administration ought to be added to power costs but they seldom are. By the way, should the damage done to earnings as a result of that lost sale be viewed as part of power costs?

If Higher Fuel Prices—What Then?

Whether or not inflation comes, fuel prices may rise. Demands for gasoline and furnace oil are requiring deeper cracking of crude and fuel oil is no longer considered a by-product. The Bituminous Coal Act's minimum prices on coal are also having their effects.

It is true that these increases will also have a bearing on the utility's cost of generation, but the effect on its rate will be far less than in the isolated plant. Many costs beside fuel enter into utility rates and in a large proportion. For example, the fixed charges on transmission and distribution are a major part of the whole and remain constant. Hydro operation (almost entirely fixed charges) tends to stabilize costs. Constantly improving technique in large scale generation and better interconnection and diversity of loads will offset the utility's increased costs. And not least among the reasons is the fact that Public Service Commissions are slow to make increases. The best answer is: take a look at the record. Utility power rates have been coming down for years and it would seem that the purchase of power is one of the best hedges one can take against price increases.

How can a power plant continue to have value if rising fuel prices knock out the savings? The equipment itself can never be liquidated back into cash—a necessary requirement of an inflation hedge. The only value of equipment lies in its saving—and if it cannot save, its worth is gone.

Don't Short Change Yourself on Depreciation

One way to make a great mistake in figuring power costs is to use the ordinary life tables for depreciation rates. Follow through with me on this because it is important:

In 1927 two small units were installed in a certain plant and a twenty year life was estimated. Five years later, expansion called for more power and a larger unit was added. This third unit was more efficient than the first two so it took over the base load. Last year still another even more efficient unit was added and this fourth machine now operates all the time, with the two oldest units used only in emergencies, if at all.

After only ten years, the old units are now relegated to stand by and any sort of uneconomical cheap unit could take their place. Furthermore, "Break-down" emergency power service can be purchased for less than the annual fixed charges still being charged on the books for these two machines and such charges will continue on for ten years more. What is wrong with this picture? Just this—these two old machines reached the end of their *real economic* life in 10 years, yet all during their life the charges were being figured on a 20 year life. Today, as far as the books are concerned, one-half of the original cost has yet to be written off. Yet all of it should have been charged off by now.

Fictitiously low have been the power costs for the past ten years, as shown by the books, having failed to carry enough depreciation. What is more—to write off now the balance will give current earnings an unwaranted headache. And even worse—the blunder may have caused an over-payment of income tax because the incorrectly low power costs will correspondingly have increased earnings but it may be too late now to do anything about it. The Treasury Department's regulations about "allowed or allowable" depreciation make such errors expensive.

This case is typical. Most machines when new are used a high percentage of the time and less and less as they grow older. And so *average* economic life is nearly *always* less than total physical life shown by life tables.

I have yet to see depreciation tables that show true average economic period of usefulness, yet the aim of good accounting is to spread costs evenly over the units produced. Carefully look into this question, in figuring the depreciation for a proposed plant because life tables are usually about twice too long.

Another point: Even the average economic life is not always attained. Drastic moves often occur in an industry such as the cotton textile mills going South and the shift of steel plants Westward. At present the automobile and tire people are decentralizing from Detroit and Akron. Little of a power plant can be taken along and such investments are therefore subject to business vicissitudes. Obsolescence rates must be ample enough to cover. Many a good power plant is to be seen today along side some abandoned industrial plant where it can be bought for ten cents on the dollar.

(*Continued on page* 330)

Commercial News Notes

By C. E. Greenwood

Commerical Director, Edison Electric Institute

DO advertising and promotion pay? The answer is always yes *if* the advertising of the product to be sold is *right,* and promotional work is effectively organized. There can be no more convincing example than the recent sales of electric ranges and roasters. The electric range manufacturers operating through the Modern Kitchen Bureau carried through their national advertising schedule in the months of April and May. Local sales pressure coordinated with national promotion resulted in a much better "recession" record on ranges than we find in refrigerators and other equipment. Considering conditions which obtain in certain sections of the country where extensive promotion of electric cooking would not be timely, the totals for four months are encouraging.

But both utility companies and manufacturers are far from content although realizing that the first four months are compared with unusually large months in 1937. Furthermore, hopes are buoyed by the plans of the Modern Kitchen Bureau for the promotion of electric cooking this fall which should bring substantial increases to compare with the lean final quarter of 1937. When this year of adversity is passed, there is general confidence that the record of sales volume on electric kitchen equipment will be a satisfactory one and an example of the power of advertising and promotion to stem the ebb-tide of sales.

One Middle West utility, convinced of the power of aggressive sales action backed up with substantial advertising appropriation, reports range sales ahead of last year; roasters running 300 per cent increase, air conditioning practically the same as last year and almost equal results with 1937 in the commercial lighting field.

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The *Modern Kitchen Bureau* program for 1938 is enjoying gratifying acceptance. Electric utilities in increasing number in all sections of the country report that the National Program has materially stimulated consumer as well as dealer interest. Each one of the four separate programs has received excellent response. These include the Electric Range Program, the Electric Water Heater Program and the general "overall" Kitchen Program.

The National Advertising on Electric Ranges featuring the National Spring Showing of Electric Ranges encouraged widespread utility and dealer support and produced excellent sales results. Local activities synchronized with the National Spring Showing report sales of electric ranges increased anywhere from 10 per cent to 200 per cent.

The Bureau has proclaimed the month of October as *"Discovery Month"* and has established a National Quota of 30,000 range sales for the month. The theme of the Campaign will be

> **"Electricity is Cheap!**
> **See for yourself that Electric Cooking costs only ½ as much as you think."**

This is based on two surveys:

(1) One thousand *new* refrigerator owners *not* having electric ranges estimated the cost of operation of a range at $5.00 to $35.00 per month.

(2) One thousand two hundred eighty-four electric range *owners* in 19 cities in the North, South, East and West were asked—"What do you think your cooking costs were for last month?" The average was $2.30 per month; 80 per cent said less than $3.00.

Each dealer will be urged to make a study of electric cooking costs in his territory, and to arm himself with "before" and "after" power bills to use in his actual selling work. He will also be urged to use this same information (the exact cost of electric cooking in his city) in his newspaper advertising, window displays and the like.

The quota will be broken down and each Regional Director will be asked to accept a quota for his region.

Promotional and advertising material similar to the materials used during the "Spring Showing" but having the *"Discovery Month"* theme will be available for local use.

October will also be *"Discovery Month"* in the Water Heating Program with the theme "What One Million *Users* of Water Heaters Have Discovered."

A series of mailings will be made to utilities and registered water heater dealers.

The Water Heater quota for the month of October has been set at 2000 sales per week, or a total quota of 8000 water heater sales for the month.

As is the range program, the water heater quota will be broken down by regions with a definite quota assigned each regional director and bureau field representative.

The Bureau's Fall Program is worthy of the support of every utility company interested in increased sales of electrical equipment and kilowatt hours.

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A junior cooking device—the roaster—which improvements in manufacture have now made one of the most useful appliances in the entire line, is gaining tremendous popularity with the public. A series of local campaign operations between utility and dealers will continue to make sales volume rise and is breaking ground for the closer acquaintance of electrical users with electricity as an ideal cooking fuel.

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Meanwhile the domestic consumption in American homes has increased approximately 9 per cent over the first four months of 1937. It is the domestic classification of business that enjoys the greatest sales pressure.

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Speaking of advertising—have you seen the portfolio of prize-winning advertisements for 1938 in the Better Copy Contest of the Public Utilities Advertising Association? The 40 pages, 15 x 11, contain advertising copy which will be a valuable reference guide to men in the promotional field. The portfolios sell at $2 each or $1.75 each in lots of five or more. Send your order to Commercial Department, Edison Electric Institute, 420 Lexington Avenue, New York City.

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Put this date down on your calendar for aggressive promotion this fall—Na-

tional Washer and Ironer Week, October 23-29. There is to be a program of stimulation of the Home Laundry inaugurated by the National Washer Ironer Manufacturers Association. The slogan is expressive: FOR THE FAMILY WASHING THERE'S NO PLACE LIKE HOME. Every utility company whether selling electricity or gas is concerned in the objectives of this campaign. There are thousands of washing machines and ironers to be sold. Many an idle washing machine can be started to work again when the Home Laundry receives the attention it deserves. In times of economic stress the family budget is carefully watched and savings are made in the operation of the household. Doing part of the laundry at home is a direct means of saving. The manufacturers will advertise nationally and are placing display material at the disposal of utilities and dealers without charge. It is expected that every utility company will give the campaign a boost through some form of tie-in and with local advertising during National Washer and Ironer Week.

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Did you read the lead article in the last issue of *Better Light-Better Sight News*? That is the important recent development in lighting promotion, namely, the action of the E.E.I. Sales Committee endeavoring to inject new energy and enthusiasm in Lighting this fall and winter.

Other references can be made to continued interest in the Better Light-Better Sight Program by important optical interests as evidenced by the challenge letter from Dr. H. E. Pine which was quoted editorially in the last *News*; to the compilation of the *Hygeia* articles into an attractive booklet which is being purchased in substantial quantities by utilities for wide local distribution; and to the new series of radio programs to be released this fall and winter by the Better Vision Institute, many of which include considerable on Lighting in conjunction with eye examination and correction of eye-sight defects.

One of the Bureau promotions this fall and winter will be the encouragement of cooperative activities locally between Lighting groups and Optometrists in developing public interest in school children eye protection during the month of September under the slogan "Send Your Whole Child to School." The next issue of the *Better Light-Better Sight News* will contain suggestions and an attractive window and counter display card is now being prepared for availability as one method of forcibly calling the public's attention to the theme.

Other items planned are the production of a new sound slide film for school children—newspaper mats—series of colored rotogravure pictorials of educational character suitable for wide local distribution—display cards pertaining to the new "Blue Ribbon" certified portable lamps.

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Last call for Broadsides for mailings to those prospects for commercial electric cooking equipment. Companies that have been tying in with the program of the Commercial Electric Cooking Council have been cashing in on this profitable business.

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Running Water! The utilities know that every farm home deserves it. Once electricity has been installed and the farmer has electric lighting, there is no sounder investment than the electric water system. The obstacle of financing, which is such a hurdle for live prospects for other electrical equipment to surmount, has been cared for by FHA insurance plans which cover the insurance of loans for both the installation of the water system and drilling of the well, if necessary. Yes, the sale of pumps is somewhat off from last year but approximately 20 per cent, which is a surprisingly good record for a substantial expenditure by the farmer. Here again the National Electric Water Systems Council promotes a product which is a sound investment, and one which will prove a contribution to a higher standard of living.

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At a recent meeting of the Electric and Gas Association of New York, Mr. W. E. Sprackling, chairman of the National Adequate Wiring Bureau, advised that an amazing local support had been accorded the Adequate Wiring Program. In approximately two months' time there were 256 cities that asked for detailed information as to how they might cooperate. There are 119 companies that purchased the Bureau's material for local action.

Local Adequate Wiring Bureaus have been organized from coast to coast and the two field men of the Bureau have been stimulating local interest in speeches at meetings from East to West.

It is of particular interest that the Electric Home and Farm Authority has offered an easy payment plan for wiring contracts in which EHFA will advance 90 per cent on wiring contracts of over $40 extending 24 months' time without recourse on the contractor. A financing charge of 5 per cent is made. It is expected that the local power company will collect the instalments under the regular EHFA contract.

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The Small House comes into its own. The limited resources of thousands who would like to build, have been recognized by architects, builders, and in fact all groups engaged in the manufacture of building materials and in building service. Extensive survey and research, coupled with the initiative of leaders in the building industry, have produced practical plans for the building of small homes within the reach of the masses.

The activities of Government bureaus, and the financing arrangements that may be made through FHA insurance in particular, puts small and attractive homes within the reach of hundreds of thousands who would not feel otherwise that they could consider such a luxury in times of economic stress.

But Public Opinion has it that "building costs are too high." In order to inform the public, and to indicate that 25 per cent to 40 per cent more home for the money can be built today than formerly, the Producers' Council, Inc., of which E.E.I. is a member, is promoting a campaign to inform the people of the facts.

These small houses are being built in *your* community. Are you following every one so that the home builder may have the advantage of adequate wiring, adequate lighting and complete cooking and water heating equipment? *New homes set the pace for the old.* Let us take advantage of this opportunity.

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The July issue of *Rural Electrification Exchange,* the third in a quarterly series, is now in press. Subscriptions have been increasing and indications are clear that the *Exchange* is giving a useful service in carrying information on rural electrical development into widely scattered areas. The Editor, E. A. Snyder, is making another appeal in the campaign to double the subscription list.

Are you a reader? Are you a subscriber? Send 25c now to cover the cost of the current issue and the Fall number. You will find this interesting and instructive reading.

Lindemann Prize Paper

A Business Woman-Homemaker Looks at the Electric Range

By Clara H. Zillessen

IT'S a lucky individual who has a hobby which helps him earn a living. I'm lucky, because the hobby nearest to my heart is cooking; and I earn a substantial part of my living by selling other people the idea of electric cooking. During more than twelve years of continuous electric cooking at home and about fifteen years of advertising electric ranges in a utility, I'm sometimes a little confused as to whether electric cooking is more important to me as a hobby or as a pleasant way of making a living!

I have been particularly fortunate in having to use my succession of electric ranges under a variety of cooking conditions. I might add parenthetically that the ranges did not wear out—they were changed whenever the lure of improved models became too irresistible. Part of the time I lived alone and did most of my cooking . . . part of the time my Mother and I swung the cooking together . . . there was also a time when my family grew to four adults with not a poor eater among them . . . and for the last several years there have been two adults and a housekeeper. A not unimportant factor in the whole situation is that my family knows good food and loves it!

I can remember that in our first timorous advertising on the advantages of electric cooking, we said a good deal about putting your dinner in the stove and going out to play bridge or golf . . . then coming home at six and taking the complete dinner out of the oven and placing it on the table with neatness and despatch. But we found out at home that there were other more important advantages.

The first thing that impressed me in doing a lot of cooking on our electric range of nearly thirteen years ago was its absolute efficiency and dependability. I had cooked on coal, wood, and gas ranges and while there was a lot to be said about their advantages, I had never gotten such perfect cooking results time after time as with that clumsy first electric range of mine. With it I could time any size of roast beef so it would always be done exactly right; my cakes, especially the layer types, were always the same; my long-cooking soups, baked hams, biscuits, such oven meal combinations as I dared foist upon the family, scalloped potatoes, a couple of puddings made according to old recipes . . . I could always count on them to turn out right every time, if I did my part first. The new electric range which sits in our kitchen today is the fourth we have had, and each one of them has been sturdily dependable in producing continuously perfect results. It's a great help to be able to set your oven temperature according to what the recipe or your experience says is correct, and be sure that there is never any variation in performance.

MISS ZILLESSEN

Miss Zillessen is the winner of the First Lindemann prize for 1938. She has been with the Philadelphia Electric Company since May, 1914. During these years she has progressed from general assistant in the Advertising Department to Advertising Manager, which position she has held since April, 1928.

Under Miss Zillessen's supervision are four departments: Advertising, Bureau of Exhibits and Displays, Home Economics and Kitchen Planning. The Advertising Department plans, prepares and produces advertising material of all types on all the services of the Company. The Bureau of Exhibits and Displays handles window and floor displays in all Company stores, and also designs and constructs exhibits for civic, association, dealer and company shows. The Advertising Department's Home Economics section is in complete charge of consumer cooking schools and public electric cooking demonstrations on company and outside properties. Functioning under Miss Zillessen, the Kitchen Planning Department offers a free service to residential customers on the Company lines.

Then there was . . . and is . . . the matter of economy. Almost everybody who came to dinner and saw the electric range would say . . . "Oh, isn't it awfully expensive?" They still say it . . . and after fifteen years of advertising electric cooking economy too! Where I live it was just about fifty-fifty as regards cost of fuel. But the other economies! I love to dilate upon the various economies of electric cooking. One that has always appealed to me was that if you use the right utensils, there is no waste heat. You pay only for the heat you use to cook your food, and not for any to flush your face or heat up your kitchen. Then there is the little matter of cooking failures. Owing to the dependability of electric range performance, no underdone cake or overdone roast is ever slipped surreptitiously into the garbage pail, and that's an economy. I hesitate to commit myself on another important economy, for fear my family will see this; but I have saved a good deal of "table" money one way or the other by not buying the most expensive cuts of meats and trusting to electric cooking to have the cheaper cuts as ten-

der and flavorful as the higher priced ones.

Being a business woman, the cost of saving labor interests me . . . the cook's or my own. Because of the ease of automatic cooking in an electric range, my cook can do other things in the house with the time which use of another fuel might cause to be devoted to "pot watching." Or, if I'm alone, I can dispense with part time maid service, because while a lone woman's dinner is in the oven, she can be doing a lot of other things. And then when the family expands again, you can save considerable fuel cost by using the deep well cooker or the oven for cooking full meals, so that you save again.

The final economy is in getting full food value out of vegetables in the surface cooking and less shrinkage of meats in oven cooking. I have read a number of tests with different fuels in relation to these things, and of course no two of them agree. But I have found out for myself in actual practice that with the half cup-of-water method of cooking vegetables, you retain the minerals and vitamins you paid for when you bought the vegetables. And I have found definitely that there is less shrinkage in roasting meats in the electric range than with any other type of cooking I have ever used. That was a saving when I have paid as high as 65 cents a pound for an extra special roast of beef! To round out this matter of economy, there is the matter of short time cooking operations both on the surface burners and in the oven . . . when you get the food started and then turn off the current, leaving the food to finish cooking on stored-up electric heat.

In twelve years, I have had my kitchen painted twice, and it has never been really dirty. That is largely due to electric cooking, I know, because I have lived in other houses with other kinds of ranges! But the chief asset to me of the electric range as far as cleanliness goes is the elimination of scrubbing bottoms of saucepans and frying pans. Like every other woman who works in a kitchen, I have my own pet technique for washing the cooking utensils (Note: my twelve year old electric dishwasher, efficient as it is, doesn't wash pots and pans like the 1938 models do!) and the truth of the matter is that when used on the electric range pots and pans do not get grimy on the bottom. I pinch-hit last Fall in the kitchen of a friend of mine when grippe ran rampant through her family, and the only thing I minded was scrubbing the bottoms of her aluminum pots and pans after they had been used on her non-electric range. This seems like a lot of words to use on pots and pans, but all women who do kitchen work have a wholehearted aversion to this tag end of the cooking job.

The question of cleanliness also extends to the electric range itself. When I was a little girl, the German part of my mother's ancestry impelled her to compel me to learn how to blacken and polish the coal range on Saturday mornings. All I can say now is that my dishcloth dipped in hot suds and then wrung out cleans the outside of the electric range like magic in a few minutes, and that the same dishcloth exploring the oven every so often likewise does a magic cleaning job.

I am an ardent follower of kitchen plans in all sorts of home and technical magazines, and I am constantly amazed at the lack of proper ventilation facilities in the kitchens of even some of the finest houses. Practically all kitchens have a good sized window or windows over the sink, but only the minority have cross ventilation or a back door in the kitchen itself as another means of ventilation. Imagine getting a nice, tricky company dinner in a one-window kitchen on a hot day anytime from April to November if you have a stove which not only heats the food, but does a pretty efficient job of heating you and the kitchen as well! My own kitchen boasts of one window, which is not even over the sink, it's small and has three doors, one to the cellar way, one to the dining room, and one to the breakfast room. (I didn't design the house!) I have been in similar kitchens of some of the other houses near me, and what a raging inferno they can turn out to be on a warm day, with an average cooking operation on a range which isn't electric! I have used my electric range, with at least three of the surface units going, the oven and the warming oven in use, and even in my poorly designed kitchen, there was no appreciable rise in temperature.

Early in this paper, I mentioned the time-releasing factor of the electric range. We advertising people like nothing better than to talk at great length about More Leisure for American Womanhood. So our advertising has invariably tried to put that thought over to the good folks of the great mass who rent our electric ranges or buy them on the installment plant. When I look over the names of the installment buyers of electric ranges in this territory every month (and they are about 80 per cent of the total buyers) I am convinced that the majority of them, such as the Slevinskys, the Murphys, the Pitulskis, the Madam Queens, the Antonios, do not have much leisure for golf or bridge. So we do not try to sell the time-release feature of electric cooking that way. We know that in hundreds of families, time-release offered by electric cooking means more time for the children and family generally, more time for the personal grooming and privacy which so many mothers of families need; more time for reading and hobbies; more time for the movies, if you will, and similar forms of escape! And only through the automatic features of the electrically controlled oven is time-release possible and practical for the majority.

I have done all sorts of time-release tricks with my electric ranges at home . . . put certain combinations into the oven before I went to work in the morning, setting the time controls so that the food would be ready when I came back in the evening; putting the main features of the dinner in the oven before taking the Sunday morning ride; putting a picnic ham and scalloped potatoes in the oven before going to the theatre or a concert, and then having the crowd in afterwards to feast upon that good hot food; putting the family dinner into the oven early on a Saturday morning, because I would be getting ready for a party in the evening and didn't want to be bothered with the last minute business of cooking dinner.

Next to the question—"Isn't electric cooking awfully expensive?" the one I hear most often is—"Isn't electric cooking awfully slow?" Well, both of these questions are guaranteed to make me mad, especially the latter. After bouts with prospects who ask that question and friends (not electric range users) who pester me likewise, I sometimes wonder whether people think that food ought to be cooked a mile a minute to be good. I like a steak seared and broiled quickly. I like roast beef cooked quickly. I don't like potatoes which have been fried over a roaring heat and are brown and dry, nor scrambled eggs which have been rushed through to a quick and disastrous finish. Most foods benefit by slow cooking . . . both in the oven and on the surface units. I had a housekeeper

(*Continued on page* 343)

Forbes Prize Paper

Public Relations in the Electric Light and Power Industry From the Inside Out

By Edmond A. Casey

MUCH has been said during the past ten years on the subject of Public Relations in the Electric Light and Power Industry, and most companies have maintained constructive programs designed to create Public Goodwill. That these programs have fallen far short of the desired goal cannot be denied. To what, other than failure, can we attribute the Holding Company Act, the move toward establishment of municipal plants and the impunity with which politicians and others state alleged malpractices by the utilities?

This paper will deal with the subject of Public relations mainly from the employee standpoint, which can be made the most important element in any campaign toward the improvement of relations with a fickle Public. To be sure, there are other factors which have an important place in any Public Relations program, but they are so obvious that a mention here will suffice.

No company should have to be reminded that its employees who come in direct contact with the Public need to be friendly and courteous. That its rate structures should be fair and easily understandable. That it should cooperate insofar as is reasonable with civic groups in its various communities. Hardly any company fails to recognize the value of strategically directed newspaper and radio advertising. Publicity should be simply done, and in a friendly way. "High pressure" should be avoided as the average person is quick to detect, and quicker to resent, such methods. Power Plants should have regularly designated visitor's days, and the Public not only invited, but encouraged to tour the plants. In this way they can be shown effectively what lies behind the light switch in their home. Ads should be run in local papers featuring employees of the company who are well known in their communities. These employees should be shown pictorially if possible, doing their daily work, or commended publicly for some outstanding act. The Public can be brought to the point of regarding a company in the same light as it regards the company's employees. If the general Public knows and respects a number of employees it will come to respect their company. These points and the many others stressed during past years are so obvious that they should be maintained as a matter of course.

MR. CASEY

Mr. Casey is winner of the 1938 B. C. Forbes Prize. He is a graduate of the Aspinwall, Penna., High School, class of 1923. From 1924 to 1928 he was in the United States Navy, during which period he worked for one year as assistant to the Personnel Officer of the Scouting fleet.

In 1928 Mr. Casey entered the service of the West Penn Power Company as Boiler and Stoker repairman. Since that time he has served as turbine attendant, assistant condenser operator, and is now condenser operator of the Springdale Power Station.

Now for the employee of the Electric Light and Power company, the most vital single factor in any Public Relations program that is to succeed. If the employees cannot speak well of their company, who can? The utility companies, having probably the lowest labor turnover of all industries, can deal most effectively with the problem of employee relations. It is safe also to assume that the utilities have a slightly higher type of employee than the average factory or mill.

It might be argued that the low labor turnover is significant; that it is conclusive evidence of satisfactory employee relations, but a reasonable argument to the contrary is that economic conditions make it advisable for employees to stay where work is steady.

It is not denied that most Light and Power companies are anxious to maintain wages at a reasonable level and to provide safe and clean working conditions. Many companies in the industry go further and provide educational opportunities, social functions and kindred advantages for their employees. What more could employees ask for? Let us try to find out.

Picture thousands of utility workers through the nation. Each one commanding the respect of his merchants and neighbors. He has the money to meet his obligations; his job is steady, making him a good risk for installment selling. He has the leisure and the money to take part in civic affairs and to belong to fraternal organizations. His wife can belong to women's clubs. His children attend school and can be proud of the fact that their Dad works for a utility company. Think of the influence each employee could command in his own circle of friends and in his community. Multiply that by thousands and you have the most powerful force for creating Goodwill that could be imagined.

Why, then, has this tremendous force not played a greater part in Public Relations heretofore? It should have for its stake in the industry is a vital one.

Primarily the employee must have working conditions, including wages, cleanliness and safety, that will make him value his job. That is the foundation upon which is to be built a favorable employee relationship. But the foundation alone is not enough. It might be stated here that most companies in the industry have the foundation upon which to build..

In a series of questions submitted to a number of employees of two Electric Light and Power companies, the workers of one company were almost unanimous in stating that their company was a "good" company to work for, while about half the employees contacted from the other company thought their company not so "good." Yet this first company, whose employees were almost unanimous in adjudging it good, pays a lower wage for the same type of work, than the second. The two plants in question are in the same vicinity, so living for both groups of employees are substantially the same. It might be added that the second company has for a considerable time past granted vacations with pay and pensions, while the first company, whose employees voted it good never pensioned employees and did not grant vacations with pay until recently. These facts would seem to indicate that as long as the wage is reasonably commensurate with the skill required, and a certain indefinable spirit maintained within the company, wages are not the all-important factor when other things are taken into consideration.

About seventy per cent of the employees of both companies thought that they were not well enough informed about proposed changes in policies affecting them. Most of the men thought they should be notified in advance and reasons given so they might fully understand proposed changes. It is easy to see that considerable resentment among employees could be forestalled by the presentation of facts behind such changes.

The answers to the next question were surprising, to put it mildly, and show definitely that something has been lacking in company policy. The question asked was, "Do you think holding companies should be abolished?" Fully fifty per cent thought holding companies should go. About thirty per cent thought holding companies would be all right if they were limited in some way. The remainder were in favor of holding companies as they now exist. These answers show that the companies have not attempted, or if they have attempted, have failed to justify to their employees the existence of the companies for which they work.

About half the employees taking part in the poll thought they were a part of their company, the other half feeling that they were just "another employee." Here again is indicated a lack of something that costs nothing and pays big dividends. Cooperation and a genuine effort toward keeping employees informed of company policy. Training of foremen and supervisors in the proper handling of men—not only to get results in work accomplished, but to avoid antagonizing employees and creating misunderstandings. Training alone is not enough, the company should follow up and see that the foremen adhere to the methods learned.

Fully seventy-five per cent of the employees questioned felt they did not know enough about the general affairs of the company to discuss them intelligently with non-employees. That is a sad state of affairs! These men who have the best reason in the world for wanting to spread Goodwill for their companies, are not well enough informed to do so.

The replies indicated that about half the employees thought the attitude of their immediate superior reflected accurately the attitude of the company toward employee problems. The other half evidently took into consideration the temperament and character of their superiors and gave the company the benefit of the doubt. Here again is indicated the importance of foremanship training.

Almost unanimously the employees felt that under no circumstances should routine wage increases due to promotions and transfers be delayed or postponed. No matter how much effort has been spent to build employee morale, failure to grant individual wage increases when they are due will counteract it.

While this poll was necessarily small in scope, it covered various departments in two companies and should be reasonably indicative. The primary aim of the poll was not to present the results as statistics, but rather to give the writer a working basis of employee opinion.

Summing the foregoing we find:

First—A large percentage of employees felt that their company was a good company to work for.

Second—Seventy per cent felt they were not informed in advance of changes in policy affecting them, and that they should be.

Third—Fully fifty per cent thought holding companies should be abolished and an additional thirty per cent thought they should be limited.

Fourth—Only half the employees felt they were a "part" of their company.

Fifth—Seventy-five per cent thought they did not know enough about their company to discuss it intelligently.

Sixth—Half of the employees assumed that the foreman reflected accurately the company's attitude.

These questions and their answers will serve to indicate what has been lacking in the past on the part of management toward building a truly loyal organization of employees to act as a first line of defense against propaganda, adverse legislation, unfavorable Public opinion and anything in general that is detrimental to the industry.

Brief suggestions to remedy the situation as applied to employees would be as follows:

First—With a large majority of employees feeling that their company is a good company to work for we have a good starting point. That is the foundation, inspired by job security, fair wages and safe, clean working conditions.

Second—Keep employees informed, when possible, of changes in policy that will affect them, and as far in advance as circumstances warrant. Cases where reasons should be given will be readily apparent to the management. When employees question the need or advisability of any change, the matter should be thoroughly explained and the company's side justified. Employees' mental processes are, on the whole a great deal like the executive's and when reasoned with they are as likely to see things as the executive himself.

Third—Employees should be told the facts and circumstances that justify the existence of the holding company as applied to public utilities. A suggestion would be to distribute an attractive pocket-sized booklet entitled "Facts about Your Company." There are four generally accepted advantages of the holding company that could be explained simply and effectively to give the employee a better conception of the structure of his company. Such a booklet should contain other information of interest and value, concerning the company. Many items would suggest themselves to the executive charged with the task of preparing such a booklet.

Fourth—If the suggestions offered here were followed they would take care of this question. A feeling of pride in his company would be instilled in each employee and he could have no feeling that he was just "another employee,"

he would know that he was a part of his company.

Fifth—The suggestion made under number three would do much to take care of this question, but not all. Employees should be kept up to date on many company policies, especially those dealing directly with the Public. The employee should know of changes or plans, when logical, before the general Public. He should know something about the general affairs of the company, including some fundamentals of the financial structure. If the employee is to play his full part in maintaining Public Goodwill he must be given cooperation by the management. It is a fact, that while the Public does not expect the mill worker to know all about the steel business, nor the factory worker to know all about his company's business, that same Public does expect the utility worker to have a knowledge of the utility business, and his company's policies.

Sixth—As indicated by the replies, half of the employees questioned accepted the foreman's attitude as a direct reflection of company policy. True, the foreman's attitude should reflect the company viewpoint, but in many cases it does not. Many petty and unjust practices indulged by foremen would never be condoned by an understanding executive. No employee's question should ever be dismissed with a gruff answer that implies he had no right to inquire. If he is wrong, it should be pointed out to him just where he is wrong. If that is done he will have a feeling of satisfaction that will spread among his fellow employees. Management should insist that foremen, supervisors and plant superintendents be reasonable in their contacts with workmen. When an employee has a wage increase due he should get it. He should not have to inquire about it or be given the impression that he has to fight for something that is rightfully his. This one point can cause a feeling of distrust to exist toward the company. Foremen should be informed of the provisions of labor contracts where such exist, and instructed as to the rights of the company and the men under the agreement. Many a case of dissatisfaction could be avoided by this precaution. A foreman should never ridicule a man about his work. If an error is made the foreman should, in a serious, friendly way show the man his mistake and instruct him so that it will not be repeated. A foreman should never be abusive, if he cannot handle his

SALES—ELECTRIC REFRIGERATORS

(Household Models Only)

MONTH OF MAY AND FIRST FIVE MONTHS OF 1938-1937

	Month of May 1938	Month of May 1937	Month of April 1938	First Five Months 1938	First Five Months 1937
Total United States	179,189	333,061	212,884	816,483	1,437,980
Maine	1,345	1,433	722	3,421	5,332
New Hampshire	566	914	452	1,993	4,039
Vermont	519	1,004	663	1,991	3,975
Massachusetts	7,294	11,367	9,571	31,452	59,349
Rhode Island	702	1,206	1,186	3,269	7,950
Connecticut	2,463	5,368	3,377	11,695	26,999
Total New England	12,889	21,292	15,971	53,821	107,644
New York	22,678	35,901	28,164	94,329	150,138
New Jersey	6,469	10,613	10,153	31,051	55,107
Pennsylvania	16,867	31,707	21,660	77,983	137,766
Total Middle Atlantic	46,014	78,221	59,977	203,363	343,011
Ohio	9,185	25,753	12,445	43,277	105,337
Indiana	4,699	9,806	5,824	21,099	41,157
Illinois	16,752	29,487	21,071	72,796	115,577
Michigan	7,245	19,294	8,630	31,739	74,773
Wisconsin	4,354	5,279	4,961	18,590	30,429
Total East North Central	42,235	89,619	52,931	187,501	367,273
Minnesota	5,333	6,429	5,250	22,161	26,839
Iowa	3,293	4,393	4,222	16,772	23,776
Missouri	4,198	10,057	5,960	25,117	44,216
North Dakota	449	507	421	1,845	2,779
South Dakota	512	621	622	2,212	3,439
Nebraska	1,376	1,931	1,857	6,859	11,301
Kansas	2,146	4,099	2,755	10,804	18,199
Total West North Central	17,307	28,037	21,087	85,770	130,549
Delaware	403	907	359	1,620	2,904
Maryland	2,238	4,447	2,986	10,207	16,984
District of Columbia	2,107	2,450	2,351	9,374	10,241
Virginia	2,166	5,606	3,347	13,385	22,734
West Virginia	1,583	4,194	2,194	8,287	18,114
North Carolina	3,436	9,161	3,228	16,292	33,603
South Carolina	1,646	3,823	1,534	6,912	15,681
Georgia	1,968	6,101	2,930	9,860	26,756
Florida	1,630	2,763	1,861	7,994	14,860
Total South Atlantic	17,177	39,452	20,790	83,931	161,877
Kentucky	2,596	4,965	2,850	10,955	19,023
Tennessee	2,493	6,450	3,004	13,403	25,197
Alabama	1,688	4,047	2,018	8,195	16,156
Mississippi	863	2,172	1,167	4,425	8,350
Total East South Central	7,640	17,634	9,039	36,978	68,726
Arkansas	863	2,170	1,395	5,128	9,190
Louisiana	1,953	3,629	2,303	10,753	14,681
Oklahoma	1,377	2,984	2,318	10,475	15,232
Texas	7,282	14,032	7,792	39,640	58,746
Total West South Central	11,475	22,815	13,808	65,996	97,849
Montana	426	1,310	256	2,178	5,647
Idaho	660	996	663	3,323	5,716
Wyoming	297	475	182	1,080	2,114
Colorado	1,665	1,789	1,169	6,250	9,877
New Mexico	323	930	456	1,673	3,239
Arizona	393	1,055	355	2,320	5,232
Utah	1,486	1,444	1,098	5,351	7,363
Nevada	286	766	270	1,044	1,891
Total Mountain	5,536	8,765	4,449	23,219	41,079
Washington	2,086	3,347	1,859	13,316	19,390
Oregon	1,547	2,065	842	6,675	10,459
California	15,283	21,814	12,131	55,913	90,123
Total Pacific	18,916	27,226	14,832	75,904	119,972

Figures based on report by the NEMA on Net Sales to Dealers and Jobbers.

men by other methods he should not be a foreman. The foreman should be the confidant of his men. If he does not know what his men are thinking of the company and its policies there is something wrong with his methods of handling men.

Let us look at a composite picture of the Electric Light and Power Company employee, to better judge the material with which we have to work. He is intelligent, and younger than his average of fifteen years' service with his company would lead you to believe. He is usually highly trained in his work, a work also demanding that he be cool-headed. He values his job and thinks well of his company. He is married, has two children and drives a car. He hopes some day to own his own home. He carries adequate life insurance or plans to, and hopes to give his children college educations.

Is that not a picture of good timber for reliable citizenship, and of an excellent prospect for cooperation with management in the preservation of the Goodwill of the Electric Light and Power industry. If these employees have not fulfilled their part in the building of favorable Public Relations in the past it is solely because they have not been provided with the necessary tools.

If the foregoing suggestions, along with others that will come to mind as the program materializes, were put into effect on the major utility systems of the nation, systematically, resolutely and conscientiously, Public Goodwill would become a reality in an incredibly short time. Picture the tremendous influence, now dormant, that would spring to life. Thousands of employees, each one proud of his company; proud of the part it plays in increasing the comfort and well-being of the nation; understanding the structure of their company and its policies; realizing its importance to them and being able to grasp the significance of present day trends of legislation and Public opinion in opposition to their industry and consequently to their interests.

Like the ever widening ripples caused by tossing a pebble into a still pool, ever increasing waves of confidence and friendliness toward the industry would emanate from this nucleus of utility employees until the voters and opinion molders of the country were cognizant of its existence.

It is as easy as that, this question of Public Relations in the Electric Light and Power industry. No other major industry in the country could maintain Goodwill so easily, and no other major industry has failed so completely to use to the fullest extent the natural gifts at its command.

Thousands of persons available for the Public Relations department, only lacking encouragement and knowledge.

Does the Industrial Power Plant Pay?

(*Continued from page* 322)

And these are not bankruptcies but are the abandonments of healthy concerns.

What Profit Rate Should Be the Objective?

Most outstanding industrial companies have a fixed policy to the effect that appropriations for improvements or for new machinery must pay out in two or three years. A recent nation wide study showed that 64 per cent of replying companies had equipment policies of three years or less, and 44 per cent two years or less. If under this policy the equipment is then used for five years, the return on the investment, after depreciation, figures out between 13 per cent and 30 per cent. Similar sound policies should be used when a power plant is being considered.

Income Taxes Can Upset Paper Profits

It was shown above that the undistributed profits tax should be added to the cost of a power plant, but have you ever realized that the Income Tax cuts into the paper showing in yet two more ways? I refer now to the effects of the 15 per cent tax on corporate net income.

First, any saving in power costs which increases the net income must be shared with the Government to the extent of 15 per cent. (Also State income tax, if any). Suppose the figures show on paper that the net saving, after interest, will be $40,000 per year. This is not the final answer. Take off 15 per cent for the tax, or $6,000, and the saving is in fact but $34,000.

Nor is this all. Bills for purchased power are classed as operating expenses and as such are wholly deductible from taxable income. But if purchased power is replaced by a private plant the allowable deduction from income for tax purposes becomes much less (even where other costs are equal). If the company has no debt then only the costs of fuel, operation and depreciation can be deducted. The interest cost, which was originally provided in the comparative paper figuring before the plant was built, because it is not actual interest that is paid out. If this interest was, for example, $50,000 per year then an additional $7,500 of income tax is paid and this is due solely to the power plant because it would not be paid if power were purchased. So often these items are overlooked.

Is This a Good Time to Build a Plant?

By this I do not refer to the hazards of doing business these days. They are bad enough to be sure but I don't believe they should hold one back from going ahead with a good venture. What I am thinking about is whether you would in effect be putting money into a proposition that has an unfavorable trend—like buying stock twenty years ago, in a horseshoe company. Today's power plant equipment is being outmoded rapidly and a great deal of improvement still seems to be in sight. Yet while this has been going on, utility rates continue to drop. If you had built a plant five years ago, you would have frozen your costs to the plant efficiencies of that date while your competitor who has been buying power all along is getting his power today at today's lower rates. To build, you freeze your costs in a declining market.

Considering what is ahead, good judgment advises to go slowly on any border-line proposition and to consider seriously only those plants that will stand a quick depreciation rate. A power plant built in competition against utility power bills must continue in the future to make savings year after year against utility rates or it is a failure.

The question of generating or purchasing is more than a casual figuring proposition. The decision is strictly a problem of economic management where responsibility lies for future success.

McGraw Prize Paper

The Gathering and Evaluation of Data for Improving 4 Kv Distribution System Operation

By Harold E. Deardorff

IN recent years, steadily increasing loads on 4 kv distribution systems have brought to the forefront the necessity for carefully studying the possibilities of effecting greater economies in operation. In addition, the increasing use of motor driven appliances by residential and commercial customers has steadily reduced the power factor of the load to a point where, in many cases, primary feeders and substation transformers have been unduly burdened with reactive power. As a result of this condition, useful capacity is limited, losses are excessive, and voltage regulation problems are magnified.

In order to correct this condition, there have been developed by the electrical industry various types of equipment which are proving quite effective in their application, namely, static capacitors, step voltage regulators, transformers with load ratio control, unit substations or their equivalent, and the primary network system.

In order to intelligently apply these various means to a specific problem, it is necessary to gather sufficient field data, organize these data into workable forms with preparation of charts, tables, diagrams, etc., and then to interpret and evaluate this information on an economic basis. It is with these phases of the problem that this paper is concerned.

Field Work

The first step in collecting data is to obtain 24-hour load curves for each feeder in question. This information should include both the kw loading and the power factor, and can be obtained from hourly station log readings of volts, amperes, and kilowatts where these are available and of reasonable accuracy. In many cases, all of these quantities are not available and in unattended substations would require a multitude of graphic records to furnish this information. In addition, considerable detailed work is necessary in order to calculate the hourly kva and kvar, which is required for later use.

A very simple method of readily procuring this information is available in the form of a graphic wattmeter with an attachment which periodically records the kvar of the circuit. The wattmeter is connected into the secondary circuits of the instrument transformers in the ordinary manner, except that the potential circuit is broken to permit the interposition of an auto-transformer. The latter is arranged to supply the wattmeter with either standard wattmeter potential, or quadrature potential for recording kvar. A small synchronous timer, energized from the main potential transformer, periodically energizes a contactor which switches the potential leads of the wattmeter from the standard connection to the kilovar connection on the auto-transformer. By adjusting the timer for a kw record of 15 minutes and a kvar record of 5 minutes, a very complete picture of the feeder load is obtained at a minimum of trouble. Samples of the type of charts obtained in this fashion are shown in Figure 1.

The 24-hour load data should be obtained for both maximum and minimum load days, which in most cases will be Monday or Tuesday for the former, and Sunday for the latter.

In addition to those load data, there should be available the electrical constants of each feeder, such as the resistance and reactance of each component part, together with the distribution of the installed transformer capacity over the feeder.

Organization of Data

After obtaining the graphic kw-kvar chart for a particular feeder or suitable equivalent instrument readings, it is advantageous to prepare a single 24-hour graph showing the kva, kw, kvar, and power factor for both the maximum and minimum load days. The information for this graph can be derived from the charts or readings previously mentioned. Where readings only are available considerable detailed work is required to arrive at the necessary values. Where kw-kvar charts are obtained, this phase of the work can be greatly expedited by the use of special scales which permit direct readings of kw and kvar from the graphic charts. Then by means of the familiar quadrant on which kw are shown as abscissae, kvar as ordinates, kva as units along radial lines, and power factor as designation for the various radii, the kva can be readily picked off along with the power factor.

MR. DEARDORFF

Mr. Deardorff is the winner of the first James H. McGraw Prize for 1938. Entering the Engineering College of the University of Cincinnati in 1917 as a cooperative student in Electrical Engineering he was at the same time employed by The Dayton Power and Light Company. During the five-year course, his working periods were spent among the Electrical Maintenance, Electric Meter, Steam Heating and Electrical Construction Departments.

After receiving an Electrical Engineering degree in 1922, he has held the following positions: Assistant Supervisor of Electric Meter Department, Supervisor of Electrical Maintenance Department, Assistant Engineer in Electrical Engineering Department, Supervisor of Test Section of Electrical Meter and Test Department, and recently Technical Engineer engaged in system planning and general engineering work.

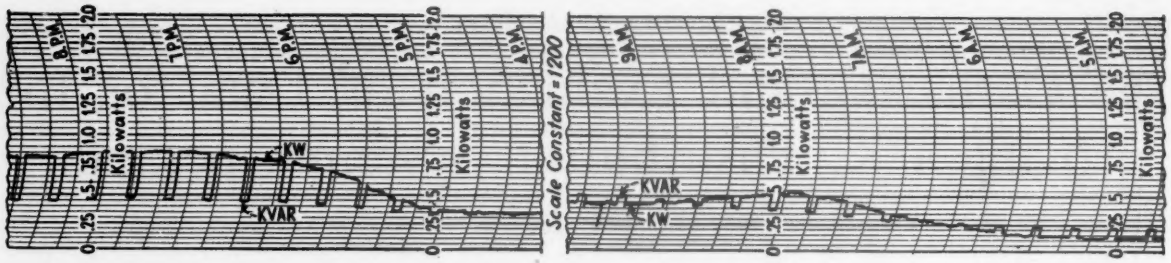


Fig. 1—Sections of a typical 4 kv. feeder load chart for a Monday
KW is Recorded for 15 Minutes—KVAR is Recorded for 5 Minutes

A typical graph derived in this manner is shown in Figure 2.

A skeleton feeder map should next be prepared, showing the main feeder and important branches. On this map should be shown, for each section, the length, type of conductor and spacing; the average maximum kva and its power factor; and the minimum kva and its power factor. The maximum and minimum kva allocated to each feeder section can be fairly equitably determined by prorating the maximum and minimum loads, as indicated by the 24-hour graph on the basis of installed transformer capacity. In making this distribution, due consideration should be given to special loads which, from knowledge possessed by the engineer, should be given only the weight due them.

A map of this type is shown in Figure 3.

For the purpose of determining the voltage regulation in any feeder section, use can be made of the principle that the voltage drop is equal to the sum of the projections of the IR and IX drops on the vector of the sending voltage. For all practical purposes, it is immaterial whether the sending or receiving voltage is used, since the angle between them is very small.

This principle can be expressed mathematically as:

$$E = IR \cos \Theta + IX \sin \Theta$$

where E = voltage drop
I = line current
R = resistance of line
X = reactance of line
Θ = power factor angle

This equation can be more advantageously used in the following form:

$$E_d = \frac{\text{kva} \bullet d \ (R \cos \Theta + X \sin \Theta)}{10 \ \text{kv}^2}$$

where E_d = per cent voltage drop
kva = average load of line section
d = length of line in thousands of feet
R = resistance per thousand feet
X = reactance per thousand feet
kv = phase to phase voltage of line
Θ = power factor angle

From this equation information can be derived for the preparation of a volt-

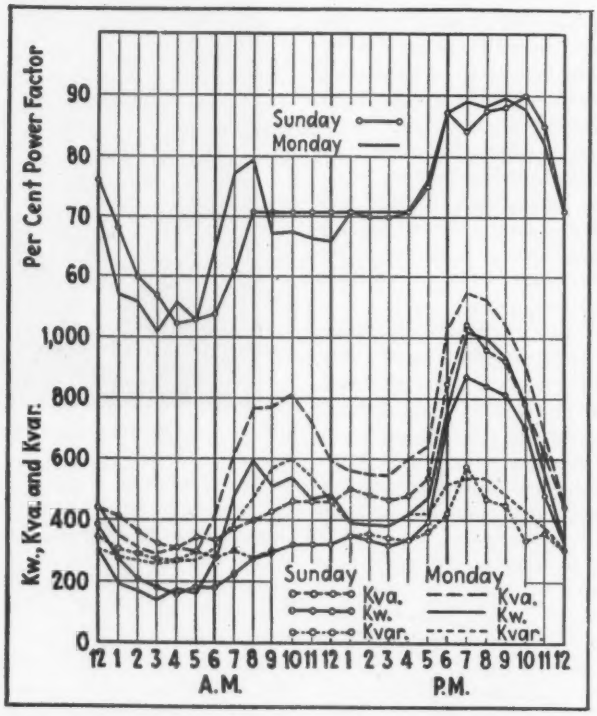
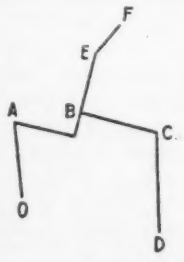


Fig. 2—Load characteristics of a typical 4 kv. feeder.



Section	Feeder Data: Length, Ft.	Conductor, No. In.	Avg. Kva. Max. Load	Avg. Kva. Min. Load	Capacitor Data: Location	Kva.
OA	2,000	4/0 @ 24	1,150 @ 0.89	327 @ 0.52	C	225
AB	2,350	2/0 @ 24	1,090 @ 0.89	317 @ 0.52	D	50
BC	2,200	2/0 @ 24	590 @ 0.89	170 @ 0.52	E	125
CD	2,700	#2 @ 24	170 @ 0.89	50 @ 0.52		
BE	1,800	2/0 @ 24	370 @ 0.89	107 @ 0.52		
EF	1,050	2/0 @ 24	160 @ 0.89	46 @ 0.52		

Fig. 3—Skeleton map of a typical 4 kv. feeder.

TABLE I—PER CENT VOLTAGE RISE PER 1,000 FEET PER 100 KVA OF CAPACITOR LOAD

Conductor	(E = 4.1 KV) Per Cent Rise (24 in. Spacing)	Per Cent Rise (48 in. Spacing)
No. 4/0 HDBC Strand	.0672	.0762
No. 2/0 HDBC Strand	.0702	.0797
No. 2 HDBC Strand	.075	.0845
No. 4 HDBC Solid	.0779	.0868
No. 6 HDBC Solid	.0803	.0904

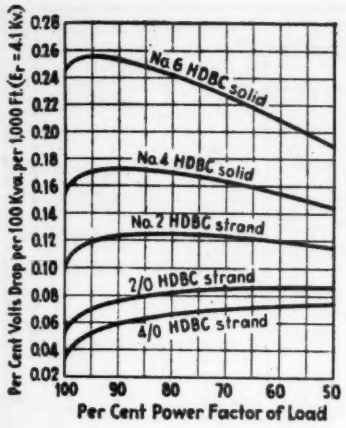


Fig. 4—Voltage drop in 4.1 kv. with 24 in. equivalent spacing

age drop chart similar to the one shown in Figure 4. In this chart the per cent voltage drop per 100 kva per 1000 feet is plotted against load power factor in per cent as abscissae. In this manner, a curve can be obtained for each conductor size used, and for a particular value of conductor spacing. In the chart shown, the nominal primary voltage used was 4.1 kv and the spacing "S" was 24 inches.

By means of regulation charts of this type used in conjunction with the skeleton map showing the feeder circuit constants and loading, the voltage regulation of the various component feeder sections under conditions of maximum and minimum loading can be readily obtained.

The effect of shunt capacitors connected to a distribution line is to neutralize a similar amount of inductive reactive load and to cause a rise in voltage due to the effect of the capacity current being supplied through an inductive line. The latter effect can be mathematically expressed as the product of the capacity current and line reactance, since this voltage will be practically in phase and additive to the line voltage.

$$E = I_c X$$

where E = voltage rise
I_c = capacity current
X = line reactance

This equation can be expressed in a more usable form, as follows:

$$E_r = \frac{C \text{ kva } X \text{ } d}{10 \text{ kv}^2}$$

where E_r = per cent voltage rise
C kva = kva of shunt capacitance
X = line reactance per thousand feet
d = length of line in thousand feet
kv = phase to phase voltage of line

By means of this equation, a table of per cent voltage rise per 1000 feet per 100 kva of capacitance load can be prepared for various sizes of conductor and spacing. Table I shows such a compilation for various conductor sizes with spacings of 24 and 48 inches and for a line voltage of 4.1 kv.

By using a table of this type in conjunction with the skeleton map previously described, the voltage rise in any section of the primary feeder for any assumed value of capacitance connected thereto can readily be obtained.

In order to obtain a clear picture of the load density of a particular area supplied by the distribution system, it is advantageous to have a map of the section ruled off in square sections of any arbitrary dimension, such as 1000 or 2000 feet or parts of a mile. By referring to the 24-hour individual feeder load graphs, maximum loading can be obtained and allocated to the various distribution transformers on the various feeders in the cross-hatched area of the map. By adding up the individual transformer loads in any square section, the peak load for that particular section can be determined.

In an area of similar loading, the peaks on the various feeders will be coincident, so that the task of determining the load density at peak is relatively simple. If the feeder loads are quite dissimilar, the task is more difficult as it requires considerable study of the various feeder graphs superimposed upon one another to obtain a peak condition. In general, it will probably be found that the load characteristics in an area of considerable size are quite similar.

Where great disparity exists between different feeders in a given area, the peak load in each square will have to be obtained by choosing a point on the various feeder graphs involved where a composite peak is reached. In such a case it would be advantageous to construct two load density maps, one showing noncoincidental peaks for the various square sections and another showing the load per section at the time of the composite peak for the entire area.

A typical area supplied by a 4 kv distribution system is shown in Figure 5. This map is cross-hatched in sections 2000 feet square and shows the load density in kva at the time of peak. In this particular case, the various feeders supplied similar loads and all peaks were practically coincidental.

Evaluation of Data

After the various data have been collected and the graphs, maps, tables, etc. have been prepared, the task of evaluating and usefully applying this information can be undertaken.

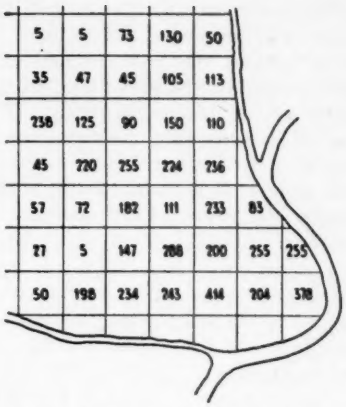


Fig. 5—Map of 4 kv. distribution area showing peak load demand in kva per 2000' square

The load density map will prove quite useful in planning immediate changes in the distribution system in that it provides information that will show where and to what extent additional facilities are required, both with respect to distribution feeders and substation and transmission facilities.

In addition, the individual load squares give very important information regarding the amount of load to be later expected in areas undergoing development. These areas will ultimately produce types of loads similar to those already existing in fully developed sections, and thus the latter can be used as criteria in predicting future load growth and planning for system expansion.

If load density maps are prepared each year, the trend of load growth due to greater use of electrical service and to real estate development can be determined. Thus, the effect upon peak demand occasioned by load building programs, such as range and water heater and better lighting campaigns, can be evaluated. With a knowledge of increased energy use, revenue, and the peak demands imposed on the distribution system, the load building activities can be more intelligently directed and emphasis placed where it is most needed.

The load density map is also useful in determining the type of distribution system, from the standpoint of economy and service requirements, that is best suited to supply a given territory. With a knowledge of the load density, the rate of growth, the type of load and general service requirements, and the physical nature of the section, it can be determined what type of distribution system

will most economically fill the need. The choice will lie among the 12 or 4 kv radial systems, the 4 kv primary network system, or the secondary network system or various combinations. The type of construction, whether underground or overhead or a combination of both, will also be determined after proper consideration is given to the various factors involved.

A voltage regulation chart for each feeder can be prepared from information supplied by the skeleton map, the regulation chart, and the table of voltage rise due to capacitors. Such a chart for a typical 4 kv feeder is shown in Figure 6. On the lower half of this chart are shown the cumulative regulation of the component parts of the feeder at maximum and minimum loads; the voltage rise due to capacitors installed at locations designated on the skeleton map of Figure 3; and the resultant regulation after considering the effect of the capacitors. These values are again shown on the upper half of the chart with the zero point relocated to show how the regulation can be cared for by voltage regulators operating in both the "boost" and "buck" positions. The narrowing of the regulation limits, together with the general voltage improvement along the feeder after the application of shunt capacitors is readily apparent.

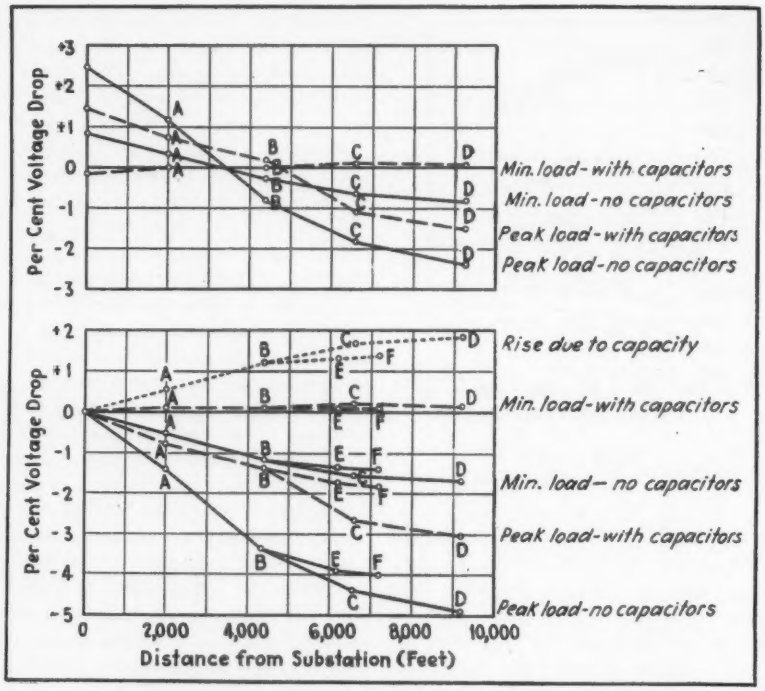


Fig. 6—Range of 4 kv. regulation with and without capacitors

On the lower half of this chart are shown the cumulative regulation of the component parts of the feeder at maximum and minimum loads, the voltage rise due to capacitors installed at locations designated on the skeleton map of Fig. 3 and the resultant regulation after considering the effect of the capacitors. These values are again shown on the upper half of the chart, with the zero point relocated to show how the regulation can be cared for by voltage regulators operating in both the "boost" and "buck" positions. The narrowing of the regulation limits, together with the general voltage improvement along the feeder, after the application of shunt capacitors, is readily apparent.

The selection of the amount and location of shunt capacitors can be determined from the 24-hour load graph of the primary feeder. This graph shows the 24-hour variations in the kvar of the feeder. By averaging this quantity a figure will be obtained which in most cases will produce the desired results. Some latitude is allowable in this respect, a larger amount of capacitance producing a greater amount of power factor correction and an increased voltage rise. The latter must be recognized as a limiting factor since the voltage rise at minimum load should not be so great as to exceed the permissible correction obtainable from the feeder voltage regulators.

In general, the location of the capacitors can be determined by allocating the total capacitance to the various feeder sections in proportion to their respective average peak loads. Where special loads obtain, or where an unusual regulation problem exists, the general principle of capacitor allocation may be modified to produce more desirable results.

One of the trends in modern distribution practice is toward the use of the so-called "unit substation," which may be either built up of an assembly of component parts by the utility company, or purchased as a complete factory assembly. Such a substation usually consists of a step-down transformer of from 750 to 3000 kva capacity which steps down the transmission voltage to 4 kv for supply to a regulated bus, either through load ratio control integral with the transformer or by means of a separate regulator. From the regulated bus, anywhere from one to four 4 kv feeders emanate to the distribution system which may be of the radial or network type.

If the system is of the radial type, care must be exercised in the application of this type of substation, to make sure that bus regulation will be adequate for the various feeders supplied, since they may differ somewhat in load characteristics and length. In this connection, the use of capacitors to aid in voltage regulation may furnish enough aid to the longer feeders or to those having the lowest power factor characteristics to enable the unit substation with bus regulation to be used.

If the system is of the primary network type, the voltage regulation problem is usually non-existent due to the fact that feeders are relatively short and are supplied from both ends.

In arriving at the answer to the question as to whether the installation of capacitors is economically justifiable, one must balance the cost of the capacitor installation against the increased consumption of energy due to the maintenance of better average voltage conditions on the feeder; the reduction in feeder losses due to increased power factor; the increase in feeder kw carrying capacity due to the decrease in reactive power; and to the releasing of generating transmission, and substation capacity due to improved power factor. In many cases the mere evaluation of any one of these factors may show sufficient justification for the capacitor installation, while in others, a complete economic analysis may be desirable.

As an aid in making these studies, the capacitor manufacturers have prepared numerous formulas and charts which enable one to evaluate the various factors involved and arrive at definite conclusions.

If sufficient data are collected properly prepared, and then evaluated, the new tools which are available may offer material aid in reducing distribution costs or at least in preventing them from increasing.

Byllesby Prize Paper

Electric Fixed Capital Accounting by Units of Property

As Required by Federal and State Power Commissions and How It May Be Accomplished

By A. C. Herron

ON June 16, 1936, the Federal Power Commission adopted a system of accounts entitled "Uniform System of Accounts Prescribed for Public Utilities and Licensees Subject to the Provisions of the Federal Power Act," with rules and regulations contained therein.

Shortly thereafter, all licensees were notified that this system of accounts, known as Order No. 42, was to become effective January 1, 1937. At the same time, the Commission forwarded to each state having a regulatory public utility commission a copy of this order with the result that several states have adopted the same classification, and those states which have not, as yet, acted are considering its adoption.

The text of this classification, insofar as the title of each account and what shall be charged or credited, does not differ greatly from other classifications of accounts being followed by most public utilities, but the method of recording and segregating these charges does. The method required is that all charges to Fixed Capital be segregated according to units of property and so recorded to substantiate the total amount charged to each account. Although units of property are not new to us, having been used by the Engineering Department for estimating purposes, their use in accounting, as required by the Commission, is something new.

The original instructions as outlined in Order No. 42 in Instruction 12, stated: "Not later than six months after the effective date of this system of accounts, each utility shall file with the Commission a list of the items of property it proposes to account for as units of property." This order, however, was rescinded December 31, 1936, with Order No. 43, and on January 13, 1937, Order No. 45 was issued prescribing a list of units of property for use in connection with the Uniform System of Accounts, becoming effective February 1, 1937.

MR. HERRON

Mr. Herron is winner of the First H. M. Byllesby Prize for 1938. Mr. Herron began work with the Florida Power Corporation, in the Purchasing and Stores Department in 1926. In 1929 he was transferred to the Florida West Coast Ice Company (a subsidiary of the Florida Power Corporation) as Chief Clerk.

In April, 1930, Mr. Herron was transferred to the Florida Power Corporation as travelling auditor and continued in this capacity until 1934. Since 1934 he has been in charge of the Fixed Capital Records Department.

The units of property as contained in this order itemized each unit of property for each Fixed Capital account. This order also stated that the units of property as prescribed would, no doubt, be revised and amended from time to time, as conditions warranted, and that they were also subject to expansion without authorization from the Commission, but they may not be condensed: thus, the units as listed in this order were of maximum size and while subdivision of these units might be made or the addition of other units permitted, the combination or increase in size of such units is enjoined.

A unit of property may be defined as one piece of material or equipment, or may consist of several pieces of material assembled to make a complete unit of property. Inasmuch as the Commission has definitely prescribed a list of units with the privilege of further segregating or making additions to these units, there should be no question as to what constitutes a unit of property for any utility coming under the jurisdiction of the Federal Power Commission or State Commission, who have adopted this classification.

The question confronting many, especially those having had no experience with Fixed Capital Accounting by units of property, is how and what method shall be used in arriving at unit costs. If it were possible for all charges to construction and retirement to originate in the Accounting Department instead of ending there, the problem would be less difficult, but as it is, the charges originate with the field men and construction gangs. These charges come to us through the use of material requisitions, time tickets, etc., and tell us how much material, time, truck and other expenses is required to do a certain job. To increase the present duties of the field men by asking them to further segregate these costs would be asking too much. We have all heard it said that the Accounting Department expects every field and construction man to be an expert accountant, as well as fitted to do the job he is hired to do, but we know, from experience, that it just does not work out in practice as well as we would like to see it.

Inasmuch as we are now required to keep accurate records of each unit of property, I hope to explain in sufficient detail how this can be done efficiently and, at the same time, lessen the accounting work that was formerly required of the field men, under the old system. However, before going into detail as to the method of procedure, let us go back to the Federal Power Classification and the instructions contained therein and review how certain units of property are to be accounted for and also what shall be capitalized and what may be charged to operating expenses.

Units of property have already been defined, so now let us review how these units are to be kept. Continuing property records are to be kept for each unit of property, similar to the way materials and supplies are now kept. Separate records are to be kept by units of property for each tract of land owned in fee, each structure, each power plant and each substation; also, each piece of office equipment, transportation equipment, stores equipment and other like items as classified under general electric property. Actual costs of these units and individual locations are to be kept for this class of property. Although separate records by units of property are also required for each transmission line of like voltage and general type of construction, like units for each line may be grouped together and an average cost used for each unit. Actual costs for each distribution unit of property may also be grouped together, arriving at an average cost for each unit, although in states requiring units for this class of property to be kept by tax districts or geographic locations, a segregation will have to be made to conform accordingly.

The accounting for units of property can, therefore, be summarized into two general groups. In the first group are units of property that are to be kept by individual costs and locations, and in the second group are like units grouped together for the entire property, tax districts or geographic locations, as the case may be, arriving at an average unit cost.

The rules to be followed in accounting for additions and retirements to Fixed Capital are also explained in the Federal Power Classification, as follows:

"For the purpose of avoiding undue refinement in accounting for additions to and retirements and replacements of electric plant*, all property shall be considered as consisting of (1) units of property and (2) minor items of property."

1. *Units of Property*

(a) When a unit of property is added to electric plant, the cost thereof shall be added to the appropriate electric plant account, except that when units are acquired in the acquisition of any electric plant constituting an operating system, they shall be accounted for as provided in electric plant instruction 4.

(b) When a unit of property is retired from electric plant, with or without replacement, the book cost thereof shall be credited to the electric plant in which it is included. The book cost of electric plant retired shall be the amount at which such property is included in the electric plant accounts, including all components of construction costs. The book cost shall be determined from the utility's records and if this cannot be done, it shall be estimated. When it is impracticable to determine the book cost of each item, due to the relatively large number or small cost thereof, the average book cost of the items, with due allowance for any differences in size and character, shall be used as the book cost of the items retired. If the unit of property is of a depreciable class, the book cost of the unit retired and credited to electric plant shall be charged to the depreciation reserve provided for such property.

2. *Minor Items of Property*

(a) When a minor item of property which did not previously exist is added to plant, the cost thereof shall be accounted for in the same manner as for the addition of a unit of property, if a substantial addition results, otherwise the charge shall be to the appropriate operating expense account.

(b) When a minor item of property is retired and not replaced, the book cost thereof shall be credited to the electric plant account in which it is included; and in the event the minor item is a part of depreciable plant, the depreciation reserve shall be charged with the book cost and cost of removal and credited with the salvage. If, however, the book cost of the minor item retired and not replaced has been or will be accounted for by its inclusion in the unit of property of which it is a part when such unit is retired, no separate credit to the property account is required when such minor item is retired.

(c) When a minor item of depreciable property is replaced independently of the unit of which it is a part, the cost of replacement shall be charged to the maintenance account appropriate for the item, except that if the replacement effects a substantial betterment (the primary aim of which is to make the property affected, more useful, more efficient, of greater desirability, of greater capacity), the excess cost of the replacement over the estimated cost at current prices of replacing without betterment shall be charged to the appropriate electric plant account."

Although the above rules, as explained by the Commission are in sufficient detail to be understandable to the man whose profession is accounting, there should be some simpler rules for the Engineering Department and field man. It is not implied that the engineer and field man are not capable of understanding the Commission's rules, but I do not believe these men interpret them in the same way an accountant would, any more than an accountant would understand some of the technical problems confronting the engineer and the field man.

A simpler set of rules devised to reach everyone, especially keeping in mind that the final entries are made in the Accounting Department, are as follows:

Units of Property Added

When a unit of property is added to electric plant, the cost thereof shall be capitalized and charged to the appropriate work order.

Parts of Units of Property Added

When parts of a unit are added, which did not previously exist, but which result in a substantial addition, the addition shall be capitalized and charged to the appropriate work order. However, if the parts added did not previously exist, but result in a minor addition, then the addition may be charged to the appropriate operating expense account.

No definite rule can be established to differentiate between when parts of units added shall be capitalized or charged to operating expenses, due to the many and varied units of equipment. The persons authorizing such changes should be able to make these decisions; although a general rule would be that parts of a unit added to distribution and transmission units would be considered minor and charged to operating expense, and parts of units added to substations, power plants, etc., would be considered substantial and should be capitalized and charged to the appropriate work order.

Units Removed and Not Replaced

When a unit of property is removed from electric plant and not replaced, it shall be retired, all costs of removing to be charged to the appropriate retirement work order. If the unit removed is usable again or has a salvage value, this value shall be credited to the appropriate retirement work order.

Parts of Units Removed and Not Replaced

When parts of a unit are removed and not replaced but which parts removed considerably lessen the value of the unit, then that part shall be retired, all costs of removing to be charged to the appropriate retirement work order. However, if the part removed does not considerably lessen the value of the unit and the cost thereof will be included

* Electric Plant is used by the Commission to mean all classes of electric property.

when the unit is retired, then the cost of removing shall be charged to the appropriate operating expense account.

The same general rule as to when parts of a unit removed shall be charged to a retirement work order and when they shall be charged to the appropriate operating expense account applies here, as given for parts of a unit added.

To illustrate this: a substation lightning arrester is a unit of property and worth a considerable amount of money. If part of this unit were removed, such as removing a section of the cells, then, that part should be retired, even though the part removed is not a complete unit of property, and all costs of removing charged to the appropriate retirement work order.

Also, considering that a cross-arm assembly is a unit of property and a part of this unit were removed, such as a cross-arm brace, thru-bolt or lag screw, this part of a unit would be considered minor and the costs of removing would be charged to the appropriate operating expense account, as the value of the parts removed would be accounted for by their inclusion in the unit of property of which it is a part, when this unit was retired.

Units Removed and Replaced

When a unit of property is removed from electric plant and replaced with the same size and kind or with a different size and kind, it shall be retired and capitalized, all costs of installing being charged to the appropriate work order number and all costs of removing being charged to the appropriate retirement work order.

The commission requires that all changes to electric property (except the purchase or sale of electric property constituting an operating unit or system) shall be recorded by means of work orders, separate work orders being opened for additions to and retirements of electric property. This request is nothing new to the utility industry, as, I would venture to say, it has been the common practice of most utilities to account for all changes in electric property through the medium of work orders for both construction and retirements. However, the requirement of accounting for units of property is something which, heretofore, has not been done and in view of the many units of property falling into the same Fixed Capital Account, the procedure of work order accounting will, of necessity, be changed from what has previously been the practice.

Another requirement of the Commission which should be mentioned at this time is the one regarding overhead construction costs. All overhead construction costs, such as engineering, supervision, general office salaries and expenses, construction engineering and supervision by others than the accounting utility, law expenses, etc., shall be charged to particular jobs or units on the basis of the amounts of such overheads reasonably applicable thereto, to the end that each job or unit shall bear its equitable proportion of such costs and that the entire cost of the unit, both direct and overhead, shall be deducted from the plant accounts at the time the unit of property is retired.

The records supporting the entries for overhead construction costs shall be kept as to show the total amount for each overhead for each year, the nature and amount of each overhead expenditure charged to each construction work order and to each account, and the basis for distribution of such costs.

Now, however, before explaining in detail just how units of property can be charged to work orders and the proper distribution of charges made to each unit and also how the segregation of overheads can be accomplished, let us review the work order procedure that has been in use by most utilities in accounting for additions to electric property.

A construction work order is prepared by the Engineering Department for, let us say, a five-pole line extension to serve John Doe. The bill of material necessary is either listed on the work order itself or a separate bill of material is attached. The Fixed Capital Accounts to be charged are also shown on the work order with an estimated amount to be charged to each. The work order is assigned a number and this number, together with the Fixed Capital Account numbers as shown on the work order, are the account numbers to be charged. Assuming that this job involved four account numbers: No. 350, Distribution Right-of-Way; No. 354, Poles, Towers & Fixtures; No. 355, Overhead Conductors and Devices, and No. 359, Services, and also assuming that the work order number assigned for this job was 100, the accounts that would be used in making charges to this work order would be 100-350, 100-354, 100-355 and 100-359. The work order is then released to the construction foreman who is to construct the line and at the same time, a copy of the work order is released to the construction accountant as his authority to accept charges to this work order. At the time the work order is released to the construction foreman, all material, labor, auto expense and sundry costs are reported by him by work order number and account number, in the proportion to each account as he thinks it should be. If the foreman knows his Capital Accounts and what items are to be charged to each, as we have always expected him to, the charges made to this work order will, no doubt, be correct.

This procedure, I believe, is the one most commonly used among utilities in accounting for charges to construction work orders, and with all due respect to this procedure, the chances are that many errors are made under this system, which are never corrected. A few of these, I shall enumerate. Usually, under this system, the construction charges are posted to a construction ledger. At the time a work order is authorized and the construction accountant has received his copy, a ledger sheet is opened for this work order number showing the total amount of the authorization and a brief description of the work to be done. The work order authorization is then filed separately, probably never to be referred to again during the period of construction or after the work has been completed.

As the work progresses, all charges that originate in the field are routed to the various departments, such as Stores, Pay Roll, Transportation, Accounts Payable, etc., where journal entries and vouchers are prepared. From these journal entries and vouchers, the construction accountant or usually a clerk who hasn't any more idea of construction or materials and supplies than the office boy, posts these charges to the construction ledger. The entries as posted on this ledger sheet usually show only the date, journal entry or voucher reference number and capital account numbers, the capital account numbers being posted in the various columns provided on this form so that all charges to each account can be totaled separately. When the work has been completed, and the construction accountant has been notified to close the work order, all charges are closed to Fixed Capital, with no thought of ever questioning the charges that have been made or classed to the various accounts.

Now, it is evident that since only the summarized charges are posted to the construction ledger, which show no detail, if erroneous charges were made, it is not likely they would be caught. It would often be surprising, if a detailed analysis were made of the material items charged to a work order and compared with what was called for on the estimate, to see the differences. It may also be just as surprising to see how unproportionately the labor and other costs have been charged. Although this is the case, it may be thought, "Well, what if more or less material were used? It was probably all used to complete the job. After all, the work order is nothing but an estimate and insofar as some of the materials and labor being charged to the wrong account, it was all charged to the work order, and all costs are capital expenditures." True, but is this good accounting?

Another thing. Instead of taking it for granted that the material as charged is correct, suppose an inventory of the line by units of property were taken and verified with the materials that were actually charged. Again, there would probably be differences. One would say that it is unreasonable to expect all material items that have been charged to a job of this nature to check exactly with what is installed, due to breakage, loss, etc., and also to expect to send a man in the field, after the work order has been completed, to inventory each job of such size. I think it unreasonable and I haven't yet said that I expected each material item to check exactly to the last thru bolt, lag screw and square washer. Neither have I said that a field man should be employed to inventory each job of this size, after it was completed. The point I am trying to bring out is that we have been generally accepting construction charges as they have originated from the field without any particular attention being paid as to what these charges comprised, or how they were classified.

I realize that the procedure I have just outlined does not apply to all utilities, but I think I am safe in saying that at some time or other this same procedure was the practice of every utility and still applies to a great majority.

Having discussed the Commission's requirements, insofar as Fixed Capital accounting and the accounting procedure most commonly used, I now wish to outline in detail how these requirements can be met and, at the same time the accounting work as formerly expected of the men in the field, lessened.

The first requirement is that the person or persons keeping the construction records must be more than just clerks. They should be experienced utility men who know their classification, materials and supplies, units of property, construction and the difficulties that are sometimes encountered, and a general knowledge of the property and how it operates. Of these, a knowledge of Accounting and Materials and Supplies is the paramount requirement. I stress Materials and Supplies as units of property are made up of these items, and units of property are now just as important to the construction accountant as account numbers.

As stated before, we have always expected the field and construction men to know accounting in addition to their other duties. Let us now tell them that they can forget what Fixed Capital account numbers stand for in reporting construction charges and, instead, use only the work order number as the account number. This will eliminate the distribution of labor and transportation or mileage hours to the various accounts. By eliminating the reporting of capital account numbers together with the work order number, it shall be necessary, however, to report by units of property all materials and supplies, either withdrawn or returned to stores. This requirement is not something that will have to be learned by the construction men, to supplement account numbers. They already know materials and supplies and after once reading over the units of property their company adopts, it will be no more difficult for them than a new account number would be for us.

Again, using as an example the same five-pole line extension to serve John Doe, let us follow it from the time of its inception in the Engineering Department through the various channels it travels, to the time it is capitalized and on the books, under the system of charging the work order number only.

The Engineering Department, in preparing a work order, estimates the material, labor, truck expense, overheads, etc., to arrive at a total cost. The material needed is also listed either on the work order form or another form which is attached. Now, instead of grouping all material items together by account numbers on the work order, the material items are listed by units of property. Generally speaking, this should be easier for the Engineering Department as, usually, their estimates are based on unit costs. After the work order has been prepared and approved, it is released to the construction foreman. The material needed is then withdrawn from stores by units of property and charged to the work order number. To illustrate how these units are to be reported on the stores requisition, it will be necessary to first itemize the units of property as called for on this particular work order. They are as follows:

5 — 40′ creo poles
6 — 8′ cross-arms and associated hardware
2 — Down guys and associated hardware
14 — Steel pins and associated hardware
14 — 2300 volt pine type insulators
2 — pole grounds and associated hardware including ground rods
197 lb.— Wire and associated items, such as sleeves, connectors, etc.
1 — 3-wire open service and associated items making up a service
600′ — Right-of-Way

The total number of units as called for are nine, of which eight will be withdrawn from stores. As these are requisitioned from stores, the following rules should be remembered in listing the items of materials by units of property on the stores requisition.

When one piece of material is a unit in itself, such as a pole, it is not necessary to write the name of the unit, as it is self-explanatory. When more than one unit is requisitioned, a blank line shall be left between units in order to more easily segregate them for stores recapping.

Units comprised of more than one piece of material are to be listed together, such as a cross-arm and associated hardware items.

Although wire is a separate unit, it shall be necessary to list all armor rods, sleeves, connectors, etc., with each size and kind, in order to segregate the different sizes and kinds, for the property records.

When units are comprised of materials which do not designate the kind of unit, the name and number of units shall be written on the requisition, just above the material items. Examples of these are, services, pole grounds, down guys, etc.

When additional materials are needed, which materials do not constitute a unit, such as a connector, the name of the unit of which it will become a part shall be written just above the item or items.

The reason for this is evident, as a connector could be a part of many different kinds of units. Items of this nature, when recapped by the stores department, will then be added to the existing units only and not considered a unit.

The same procedure, as outlined above, of course, applies to material returned to stores.

The material is then hauled to the site of the job and all truck expense going to and from the job is charged to the work order number only, as is all labor used in construction.

Miscellaneous supplies purchased in the field are either reported through petty purchases or petty cash reliefs, and are charged direct to the work order number. If the material as purchased is applicable to a particular unit, then this should be shown on the purchase order or voucher, but if it is for items such as ice, postage stamps, telephone calls, etc., no explanation is necessary insofar as the unit of property is concerned.

No mention has been made of the work order form up to now, but before leaving the construction foreman and his duties, it would be well to explain briefly the work order form to be used.

The heading of the work order form shows the name of the company, work order number, date, description of project and division or district. The main body of this form is left blank for listing units of property and costs and describing the work to be done. At the bottom of this form, there is a space for the person preparing the work order to sign and sufficient spaces for various other signatures as required for approval. If the work to be done is of such size that the units of property cannot all be listed on this form, a separate list is prepared and attached to the work order. The reverse side of this form is used entirely by the construction foreman in reporting the following information: date work started; date work completed; date cut in for operation; operation satisfactory; have all charges been forwarded to the Accounting Department; will there be any additional charges to complete project. These questions require no lengthy answers as, in most cases, they are only the dates and "yes" or "no." Sufficient space is provided just under these questions for describing any changes from the original work order.

The above questions and information can be answered easily in a narrow space at the top of the form and the remaining part of the form is used for listing the unit of property installed, or removed, as the case may be. If any units were broken or lost, such as insulators, then, this fact should also be noted. Opposite the space provided for listing the units of property are two columns. The first column is used for listing the number of units installed. The other column is used for reporting the number of units removed in connection with retirement work orders. Space is also provided on this form for the Foreman's signature.

After the work has been completed by the construction crew and all field charges routed to the appropriate Accounting Departments, the construction foreman or someone designated by him, inventories the completed project by units. In reporting these units, it is not necessary to report all material items making up the various units; only the kind and number of units. In addition, all other questions that appear on this form are answered by the construction foreman, as previously explained. The construction foreman then returns the completed work order form to the Engineering Department.

Returning to the various other forms that were used by the construction foreman in reporting charges for constructing this line, I will return first to the stores requisition and credit slips.

All requisitions and credit slips used for charging and crediting stores materials are now in the Stores Department and in the process of being recapped and priced. Instead of being recapped and priced by work order and capital account numbers, they are now recapped by work order number and units of property. Therefore, no additional work has been added to the Stores Department, as the recapping of materials by units and work order numbers requires no more work than was previously required in recapping by various capital accounts and work order number.

The daily transportation reports have also been forwarded to the Transportation Department where the charges are accumulated. Here the total cost is charged only to the work order number. If, however, transportation expense was incurred by the engineer or system construction supervisor, it should be charged to the work order number with the capital letter "E" immediately following the work order number. This is to distinguish the transportation charges that should be classed as overhead expense from direct transportation expense. A decrease in work in this department has been accomplished by eliminating the number of accounts from several for each work order, to not more than two.

The daily time reports that the construction foreman originates are also accumulated in the Pay Roll Department and charged to the work order number only. Time chargeable by engineers and supervisors is also charged to the work order number with the capital letter "E" immediately following. This is also to distinguish the local engineering and supervision overhead charge from the labor as charged for actual construction. Here again, the work has been reduced from several accounts involved to only two accounts.

Miscellaneous supplies charged through petty purchase orders, petty cash vouchers, expense accounts, etc., clearing through the Accounts Payable Department are also charged only to the work order number, except of course any expense originating with the engineer or supervisor that is classed as overhead, and again not more than two accounts are involved for each work order.

Therefore, by changing to the method of reporting materials and supplies by units of property, the number of accounts formerly needed to accumulate charges in the various departments for each work order has been reduced to one account number in the Stores Department and to not more than two accounts in the other departments.

All charges for this example five-pole line extension have been accumulated in the various departments and are now ready for posting by the construction accountant. At the time the work order is approved and given to the construction foreman, a copy is sent to the construction accountant. This copy is filed in a regular letter-size folder, together with sufficient blank forms for posting all charges that are apt to be made to this work order. In addition to this, the work order number and a brief description is typed on the file folder tab for easy reference. The form used for posting the charges is of letter-size with columns provided for date, journal entry and voucher number reference, a wide column for description and three money columns, to be used

for materials, labor and sundries, respectively.

The material as charged to the work order, clearing through stores, is then posted from the journal entry, in total, in the material column. The stores recap sheets showing all items of materials by units are also filed each month in the work order folder, to support in detail the total amount as posted from the journal entry. The total construction labor charges are posted from the journal entry in the labor column and described as construction labor. Any labor charged to the work order number and the letter "E" is also posted in the labor column, but described as local engineering and supervision labor.

The total transportation charges are posted in the sundry column, but segregated in this column, if the journal entry shows charges to both the work order number and the work order number and letter "E," with the appropriate description, such as construction transportation charges and local engineering and supervision transportation charges.

Miscellaneous charges are posted from the vouchers and journal entries in the appropriate columns, with sufficient descriptions for each charge or charges.

As stated before, upon completion of the job, all units installed are inventoried by the construction foreman or someone designated by him and reported in the space provided on the back of the work order form. After this has been done and all questions answered, it is signed by him and returned to the Engineering Department. After examining the completed report and mapping it, it is then routed to the construction accountant. Receipt of the completed copy by the construction accountant is notice that the work has been completed and may be closed to Fixed Capital. It is also an inventory of units installed, made and certified correct by the person who had charge of their installation. The units of property, as inventoried, are then verified with those that are actually charged. No attempt is made to balance each material item making up the various units, against each other, as only the total number and each kind of unit are inventoried, and if it were known the number of bolts, washers, etc., that were used, I believe that the verification of these items would be one step too far in detail.

Wire, however, cannot be inventoried easily after it is up, but the same net number of pounds charged to the job should be reported on the inventory as being installed, and to verify this unit it shall be necessary for distances and the number of phases to be shown on the original work order, in order for the construction accountant to compute the number of pounds. The computations arrived at seldom will agree with what has been charged, but will serve as a guide whether or not the number of pounds as charged should be questioned.

However, each unit of property, such as the number of poles, cross-arms, pole grounds, insulators, services, etc., should check. If the inventory does not agree with what has been charged, the first step is to verify the stores recap sheets with the individual stores requisitions. After this has been done and found to be correct, then the construction foreman should be notified and called upon for an explanation of the differences. If this procedure is followed, you can be assured that the inventory and the units charged will invariably agree, as both the charges and inventories originate with the construction foreman.

After reconciling any differences, the work order is then ready for unifying. Unification of a work order may here be defined as charging to the known units of property the accumulated costs, such as labor, transportation, overhead and other miscellaneous charges on an equitable basis to the end that each unit receives its proportionate amount.

For simplification in unifying the work order, the use of accountant's columnar working papers for recapping the accumulated units and other charges that have been posted to the work order folder is recommended. The first step is to summarize and recap on a letter-size, two-column, with name space, columnar sheet, the total charges made to the work order, grouped in the following sequence:

All material charged to the work order through the Stores Account is recapped and sub-totaled. All miscellaneous, sundry items charged from vouchers or charged from journal entries not clearing through stores, that can be charged to specific units, are recapped and sub-totaled. These two groups of charges are then totaled arriving at the total material costs and direct charges for units.

All construction labor costs are recapped, except labor classed as engineering and supervision. To this is added crew expense, workman's compensation, insurance, pay roll taxes and similar expense items, which are sub-totaled. Labor expense for clearing right-of-way is then deducted from this sub-total and the difference extended in the total column. The same amount as deducted for right-of-way labor is then extended in the total column and classed accordingly.

Charges, such as tools and transportation expense, are sub-totaled. Each class of overheads is summarized whether direct or indirect, such as interest, engineering, and supervision, general administration, etc., and each class sub-totaled. The sub-totals for these are now totaled. All charges have now been classified according to the above headings and the grand total of these is the same as the total charges made to the work order.

The next step is to recap the units of property and spread the undistributed charges to these units to the end that each unit is charged proportionately. This is best done by using a 13 column, columnar sheet with name space. At the top of each column, written in the space provided, is listed the name of each unit. In the name space column is written materials withdrawn from stores. Opposite this heading and listed in the various unit columns, shall be inserted the total number and value of like units, as taken from the stores recap sheets. Listed next are miscellaneous material items whose cost can be classed direct to specific units but which did not clear through the material and supplies account. The total stores and sundry costs are then added together to arrive at total material costs for units of propery. This total is then in agreement with the total material costs as recapped on the summary sheet.

The next step is to properly distribute the labor charges. It is a foregone conclusion that labor costs cannot be prorated on a unit value basis to arrive at an equitable distribution. Therefore, the labor is spread by using certain labor cost factors, a separate factor being used for each class unit. These factors are arrived at by making a time study for each kind of unit installed. After these factors are once arrived at, they become fixed and can be applied to all similar units of property installed. Inasmuch as all units of property applying to the distribution and transmission property are analogous, a factor can be arrived at for each unit for this class of property. It

Exhibit "A"

Work Order No. 100

Construct Five Pole Line Extension to Serve John Doe

(Example of Unified Work Order)

Summary of Fixed Capital Accounts
As per Itemized List of Units

350	$ 28.05	11.24%
354	112.91	45.27%
255	94.56	37.91%
359	13.92	5.58%
Total	$249.44	100.00%

Distribution of Overheads by Accounts

	Interest		Eng. & Super. Other	Eng. & Super. Local	General Adminis.	Total
350	11.24%	$ .22	$ 2.02	$ .79	$ .56	$ 3.59
354	45.27%	.91	8.15	3.17	2.26	14.49
355	37.91%	.76	6.82	2.65	1.90	12.13
359	5.58%	.11	1.01	.39	.28	1.79
Total	100.00%	$2.00	$18.00	$7.00	$5.00	$32.00

Exhibit "B"

Work Order No. 100

Construct Five Pole Line Extension to Serve John Doe

(Example of Unified Work Order)

Work Order Charges Summarized

		Sub-Totals	Totals
Total Material Costs			$99.19
Sundry Costs Chargeable to Specific Units			
Staples	Pole Grounds	$ 1.00	
Hauling Material (Outside Truck Hire)	Poles 40′	5.00	
Hauling Material (Outside Truck Hire)	Cross-arms	.50	
Hauling Material (Outside Truck Hire)	Guys	1.00	
Hauling Material (Outside Truck Hire)	Wire TBWP	.75	8.25
Labor Costs			
Payroll Charges		$75.00	
Meals for crew		10.00	
Ice for crew		2.00	
		$87.00	
Less Right-of-Way Labor Costs		21.86	65.14
Labor for Right-of-Way Clearing			21.86

Indirect Unit Charges

Sundries			
Tools	$ 3.00		
Auto Expense	20.00	23.00	
Overheads			
(a) Interest	$ 2.00	2.00	
(b) Engineering & Super. (local)	5.00		
Expense Account Eng.	1.00		
Auto Expense Eng.	1.00	7.00	
(c) Eng. & Super. (other)	18.00	18.00	
(d) Gen. Administration Capitalized	5.00	5.00	
Total Charges to Prorate to Unit Costs Materials and Labor			55.00
Total Charges to Work Order			$249.44

is immaterial whether these labor cost factors are based on a high or low labor rate as they are to be used only as factors and the actual labor that is prorated according to these will always be in the correct proportion. The only unit where a factor cannot be applied successfully is the right-of-way unit. To surmount this exception the amount of right-of-way labor cost is deducted from the total labor charged before it is spread to the physical units. Where right-of-way labor costs are incurred, the construction foreman should notify the construction accountant if the actual costs exceeded or was less than the estimated amount on the work order and in what amounts. This amount is then used as the labor cost for the right-of-way unit. This will explain why on the recap sheet where all charges to the work order were summarized the right-of-way labor was deducted from the total labor charged.

The corresponding labor factors are then multiplied by the number of like units to arrive at a unit proration base. The total construction labor, which has been previously recapped is divided by the total of all unit proration bases to arrive at the proration factor common to all. This proration factor is then multiplied by the proration base for each class of units and the total labor costs for each class of units is arrived at.

The total labor costs by units is then added to the total material costs by units, with the result that we now have the total material and labor costs by units. Added at this time is the total right-of-way units, the right-of-way unit being one foot and in multiple thereof, and the total amount of right-of-way labor, as set forth separately on the recap sheet wherein all charges to the work order have been summarized.

Before going further at this time in prorating the balance of charges, there may be some who question the above method of spreading labor charges, on the theory that it may actually cost more to set certain units as compared with others. This may be true, but since we know have to keep installed costs by units, this method is better than depending upon the construction foreman to charge the time spent in installing each kind of unit to arrive at a so-called actual cost. To prove this: I know from experience, if the construction foreman were required to report his time according to each unit installed, only labor costs for the larger units would be charged and the distribution of time to these would be no more than a guess on his part. I say this and at the same time have respect for his judgment, but it is not possible for him to manage a crew of men properly and at the same time be a time-keeper for each unit of property. However, a better distribution would not be had, even if a time-keeper were employed to do nothing else but report time by units.

All material and labor costs have now been added together and segregated according to units. To these unit costs will now be spread the charges that cannot be associated to any particular unit,

EXHIBIT "C"

WORK ORDER No. 100

Construct Five Pole Line Extension to Serve John Doe

(Example of Unified Work Order)

SUMMARY OF UNITS OF PROPERTY AND THE DISTRIBUTION OF ALL CHARGES

	Poles 40′ Creo	X-arms 8′	Guys	Pins Steel	Insulators 2300 Volt P. T.	Pole Grounds	Wire TBWP	Service 3-Wire Open	R/W	Total
(A) Material Cost and Units	5 $23.66	6 $8.43	2 $10.56	14 $3.68	14 $3.22	2 $4.32	197# $38.09	1 $7.23	600′	$99.19
Sundry Costs	5.00	.50	1.00			$1.00	.75			$8.25
Total Units and Material Cost	5 $28.66	6 $8.93	$11.56	14 $3.68	14 $3.22	2 $5.32	197# $38.84	1 $7.23	600′	$107.44
(B) Labor Proration Base	17.00	4.26	4.44	.56	.84	.88	17.927	2.70		48.607
(C) Common Labor Proration Factor	x 1.3401	x 1.3401	x 1.3401	x 1.3401	x 1.3401	x 1.3401	x 1.3401	x 1.3401		
(D) Total Labor by Units	$22.78	$5.71	$5.95	$.75	$1.13	$1.18	$24.02	$3.62	$21.86	$87.00
Total Material and Labor Cost	$51.44	$14.64	$17.51	$4.43	$4.35	$6.50	$62.86	$10.85	$21.86	$194.44
Indirect Unit Costs Prorated: (E) Factor .28286	$14.55	$4.14	$4.95	$1.25	$1.23	$1.84	$17.78	$3.07	$6.18	$55.00
Total Units and Cost	5 $65.99	6 $18.78	2 $22.46	14 $5.68	14 $5.58	2 $8.34	197# $80.64	1 $13.92	600′ $28.05	$249.44
Capital Account Number	354	354	354	354	355	355	355	359	350	

(A) The number of units and material unit costs is recapped from the stores recap sheets and also from any other charges that can be charged direct to units. The material costs include unallocated stores expense.

(B) Labor proration base is arrived at by multiplying the number of units by the corresponding labor cost fa ctor. For a list of labor cost factors applying to distribution line units as charged on this work order, refer to EXHIBIT "D".

(C) Direct labor costs — $65.14 / Labor Proration base — 48.607. = Labor proration common factor 1.3401

(D) Labor costs for each class of units

(E) Total indirect unit costs — $55.00 / Total Material and labor costs — 194.44 = Proration factor for unit costs .28286

such as transportation expense, charges not applicable to particular units and overhead charges. These costs are now spread on the value basis of materials and labor. These charges have also been previously summarized and totaled on the recap sheet. This amount is then divided by the total amount representing materials and labor and the factor arrived at is multiplied by these unit costs, the result being an equitable charge to each class of units for such costs as these. The Commission's requirements are then met, insofar as spreading these overheads, as they state "overheads shall be charged to particular jobs or units on the basis of the amounts of such overheads reasonably applicable thereto, to the end that each job or unit shall bear its equitable proportion of such costs." These prorations are then added to the materials and labor costs and the total represents the total cost of each class of units, including all charges.

All costs have now been allocated to units and the next step is to classify these units to the Fixed Capital accounts. The total amounts are then summarized by capital accounts, this summary being listed on another letter-size columnar sheet. After the summary has been completed, the total amount as arrived at by capital accounts is the same amount as the total charges made to the work order. The work order can then be closed to Fixed Capital.

However, there is one more step to be taken before the work order is completely unified. This step is to comply with the Commission's requirement wherein they request that "the records supporting the entries for overhead construction costs shall be so kept as to show the total amount for each overhead for each year, the nature and amount of *each* overhead expenditure charged to *each* construction work order

EXHIBIT "D"

PERMANENT LABOR COST FACTORS FOR DISTRIBUTION UNITS OF PROPERTY

	Total Labor Installed
40′ Creosoted Poles	$3.40
8′ Cross Arms	.71
Steel Pins	.04
Guys—All Kinds—All Sizes	2.22
Insulators—Pin Type, 2300 Volt	.06
Wire—TBWP Solid Copper Per Lb.	.091
Pole Grounds	.44
Services—3 wire open	2.70

The above labor cost factors are only those used in connection with the unification of example work order No. 100 and are not a complete list of the factors for distribution and transmission units.

and to *each* electric account and the basis for distribution of such costs."

To comply with these requirements, the total amount as classified to each capital account is converted into a percentage of the total amount charged to all accounts. The percentage for each account, as arrived at, is then applied to each class of overheads as already shows on the summary sheet. Thereby, each overhead as charged is segregated between each capital account. This schedule of overheads showing the amounts charged to each account for each class of overheads is summarized on the same sheet that the summary of capital accounts was included on.

The work order is now unified in accordance with all the Commission's requirements and may now be posted to the detail units of property ledgers.

The procedure outlined is all done in the construction accounting department and may sound very complicated, but in reality, it is very simple, especially with the use of a calculator, for the average accountant to understand and complete.

Now, a brief review of what has taken place. Upon completion of the job, the completed work order ended in the construction accounting department. After being checked and any differences reconciled, all charges were summarized on a columnar sheet. This summary included the subtotals and totals of different class charges necessary to be known for proration purposes, divided mainly into three general groups; materials, labor and overheads. Listed on another columnar sheet, was the units of property to which all of these charges were prorated. After all prorations were made the summary by capital accounts and the list of each overhead by accounts were listed on another columnar sheet. The work order now has been unified and all working sheets together with the completed copy of the work order, are filed permanently in the work order folder. By using a work order folder as compared with using a construction ledger, all working papers, letters, etc., pertaining to the work order may be filed in one folder, and if necessary to refer to this job at a later date, the history of it is in one folder.

Labor unit factors cannot be applied to other classes of property, such as substations, power plants, etc., but for work of this nature the Engineering Department in preparing the estimates can show the estimated labor costs for installing each class of units and these estimates used as factors in spreading actual labor costs; otherwise, the procedure is the same.

For major construction jobs, such as a power plant addition, where it is not practicable to estimate the labor unit costs to be used as factors, sub-accounts may be used with the work order number, the sub-accounts representing the different units of property.

For a more lucid explanation of the procedure as outlined in the foregoing, refer to the accompanying exhibits, "A," "B," "C," and "D," which illustrate further the method of unifying work orders as recommended in this paper.

Nothing has been said of retirement work orders, but the same work order form can be used for these as was explained for construction. The only comment that is pertinent at this time is that all units of property removed should be reported on the reverse side of the work order form in the column povided and the retirement from fixed capital entry prepared from this information received from the field representing what was actually removed, instead of retiring on an estimated number of units prepared by the Engineering Department.

It has been my desire to explain in sufficient detail how units of property may be accounted for to comply with the Federal Power Commission's uniform system of accounts and, at the same time, prove that the burden of field accounting can be lightened by making charges to the work order number only.

A Business Woman-Homemaker Looks at the Electric Range

(*Continued from page* 326)

once who used to love to cook a leg of lamb at a gallop, and what awful lamb it turned out to be. It took me a long time to teach her to cook poultry, veal, pork and lamb with slow and loving kindness. And it was hard at first for her to understand that vegetables gently boiled in half a cup of water were infinitely better than those boiled in lots of water at such breakneck speed that she would almost have to sit down on the pot cover to keep it down. She felt because she didn't see an actual flame there couldn't be much heat. When she finally learned how easy it was to cook vegetables, make cream sauce, cook cereals without a double boiler, scramble eggs gently, and do a smooth uncurdled hollandaise on the surface units of the electric range, she was a convert to electric cooking. Speed in cooking, in most cases, is undesirable; but it's hard to explain that to the not-so-small portion of the American public with poor food standards, whose idea of cooking a meal is to fry steak and potatoes at top speed at the last minute, open a couple of cans of soup and vegetables and heat them to a rapid boiling point in the shortest possible time, and call it a meal. And it's still harder to make them understand that an electric range, after all, cooks foods just as fast as foods can cook.

I love the beauty and lines of my new electric range. Its porcelain finish is so white and gleaming; its ovens so clean looking; its metal trim so shiny; its accessories so important looking. We advertising folks know that "pride of possession" is one of the major points of appeal in selling merchandise, and how true it is in this business of selling electric ranges. It's difficult for me not to show off my electric range to all and sundry because I am so proud of it. What a far cry it is from my original electric range of almost thirteen years ago . . . just as the car I have now is awfully different from the first Ford Model T of which I was so proud!

I do not think there is any question but that the new ease, dependability and convenience of electric cooking is making us Americans more food conscious. In spite of our unequalled sources and supplies of foods, the experts say that by and large our food standards are not what they should be. But now, many a woman who would have been scared to death to bake an angel cake or put together a hollandaise sauce on her old range will fearlessly try them on her new electric range. And many a woman who used to boil her vegetables at top speed and unknowingly cheat her growing family of the necessary vitamins and minerals, is thankful that she bought an electric range and can cook her vegetables to save all those important elements. And it is perfectly true that many women are developing an altogether new interest in food, cooking, nutrition and home-making generally just because they have been able to finally secure the perfect cooking medium . . . an electric range.

It's one thing to be in the advertising end of an electric utility and to put out advertising selling the electric cooking idea because the manufacturer, the merchandise folks, the laboratory tests and the magazine advertising tell you that electric cooking is the ultimate. Couple that with more than twelve years of experience in your own kitchen, added to a very real interest in food and cooking, and if the electric range still seems to be all that is claimed for it, then it certainly must be the last word in cooking!

The Use of Power Factor Test Equipment for Indicating Defective Cable Terminals and Network Transformers

By M. W. Ghen
Duquesne Light Company

A paper presented before the Transmission and Distribution Committee, E.E.I., Chicago, May 3-4, 1938

THE employment of portable high voltage power factor test equipment for the detection of defective high voltage bushings and metering transformers has been standard practice with a number of operating companies for several years. It is believed, however, that its use in locating defective cable terminals and network transformer testing are relatively new fields for this equipment. It will be the purpose of this paper to discuss results obtained in the field testing of 302 cable terminals and a number of network transformers, together with operating features connected therewith.

Overhead Terminal Inspection

As a result of the examination of several failures of an obsolete type of cable terminal having dry and wet 60-cycle flashover values of 190 kv and 140 kv respectively and used on the 22-kv system, it was decided that they were caused by a combination of moisture entering the terminal and the presence of an inferior type of filling compound which had not thoroughly adhered to the inside of the porcelain bushing. In addition to moisture, numerous large voids were found in the filling compound. Actual failure, in most cases, resulted in flashover from the top parts of the terminal, through the junction between the inside cylindrical surface of the porcelain bushing and the filling compound to the grounded shielding bell in the base. Several of the terminals were returned to service in their damaged condition to be found later by inspection. Detailed inspection of the terminals disclosed the fact that the moisture was drawn into the terminal through a porous cemented joint between a metal ring and the porcelain tube at the top. In some cases, moisture had also entered through a cemented joint between the porcelain and the body. Unlike later designs, this terminal was not arranged for gasketing to the porcelain.

In considering methods available for field testing other terminals of this type, it was decided that the power factor test set was desirable because it indicates most accurately the general condition of the terminal. While the megger may indicate terminals in very bad condition, it was not deemed satisfactory because it failed to differentiate between the satisfactory terminal and the terminal which contained voids or moisture in small quantities.

During the use of the test equipment in the field, proper care had to be exercised to insure safety and accurate results. The method of testing required the removal of the terminal from its support and temporary suspension from the hood nut which is at ground potential during the test. Two inches of the lead cable sheath were then removed at a distance of six inches below the bottom of the terminal. Shield electrodes were applied to this point and to the porcelain just above the metal body so that creepage current at these two points would not affect readings. The cable conductor was then grounded and test potential applied to the body of the terminal.

The testing equipment used was the conventional inverted "Schering" bridge, a diagram of which is shown in Fig. 1. The bridge is equipped for complete shielding as shown in dotted lines on the diagram. The shield circuit is balanced by the use of the inductance L_{sh}, the resistance R_{sh}, and the capacitance C_{sh}. After the shield circuit has been balanced, a balance is obtained on the bridge, and the cotangent of the angle between the current and voltage is read directly at C_4; while the reading R_3 is proportional to the resistance of the sample. From the latter reading, the capacity of the sample may be obtained by applying a constant. Energy for the bridge test was obtained from secondary or primary circuits and, in a few cases, by energizing at low voltage the overhead transmission line conductors themselves.

Some attempts were made to test the terminals and line together, which allows the test potential to be applied to the line conductor and obviates the necessity of ringing the lead sheath. This method is not satisfactory because the large capacity of a good cable tends to mask the conditions prevailing at the terminals which comprise only a small fraction of the total capacity, making it difficult to detect improper filling or the presence of voids in the terminals. If the power factor of the terminal is extremely high, it can be detected in a measure, depending on the length of the cable.

In a few cases, the so-called "hot collar" test was tried. This test consists of applying the test potential to a metal band placed between petticoats of the terminal, while the cable conductor and terminal body are grounded. It is possible, with this test, to detect moisture in very small quantities which is confined entirely to the top region of the terminal. Its use near the lower end of the bushing is of doubtful value in detecting moisture contained within the area enclosed by the metal body.

In order to determine the effect of field temperature variations on the power factor of the outdoor cable terminals, data as shown in Fig. 2 was obtained from a newly assembled terminal of the same design. All field testing was done between temperatures of 5°C and 37°C between which temperature limits test values of power factor were found to be .33% and .45%. Temperature corrections for this range were, therefore, considered negligible and were not applied to the results obtained.

Results obtained on 187 terminals installed on paper-insulated, 22-kv cable are shown in Fig. 3. Removal and inspection of a number of individual terminals scattered throughout the entire range of results made possible the segregation of these terminals into three classes, as follows:

1. Those falling within the inner zone were found to be in excellent condition and were assumed to be satisfactory for continued operation.

2. The terminals in the intermediate or doubtful zone were found to contain only traces of moisture and a few small voids. Operating experience with this type of terminal indicates that these terminals are safe to operate for an indefinite length of time, and as a result they have been scheduled for further inspection in from two to three years.

The terminals falling outside the doubtful zone were all found to be defective and, in many cases, to be well ad-

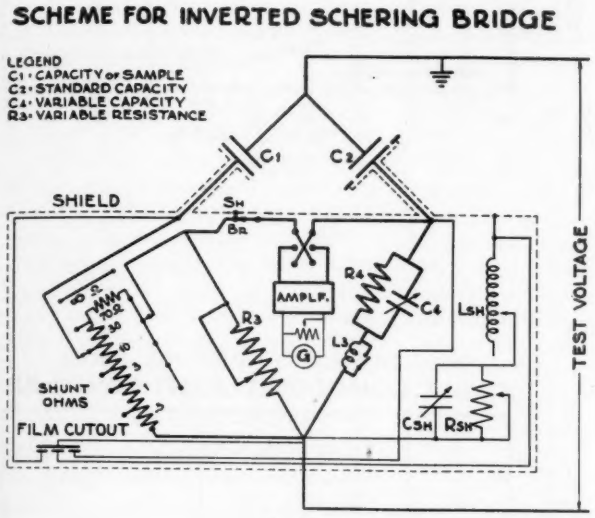


Fig. 1

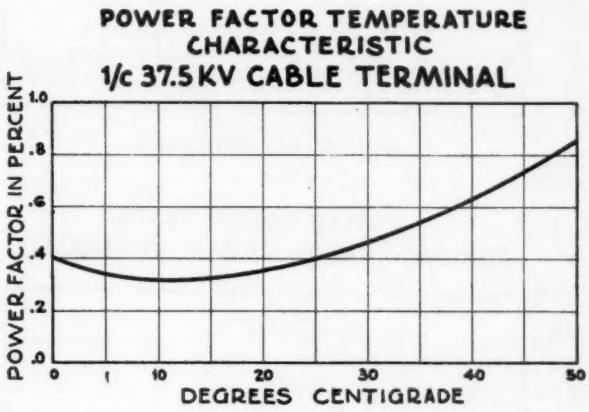


Fig. 2

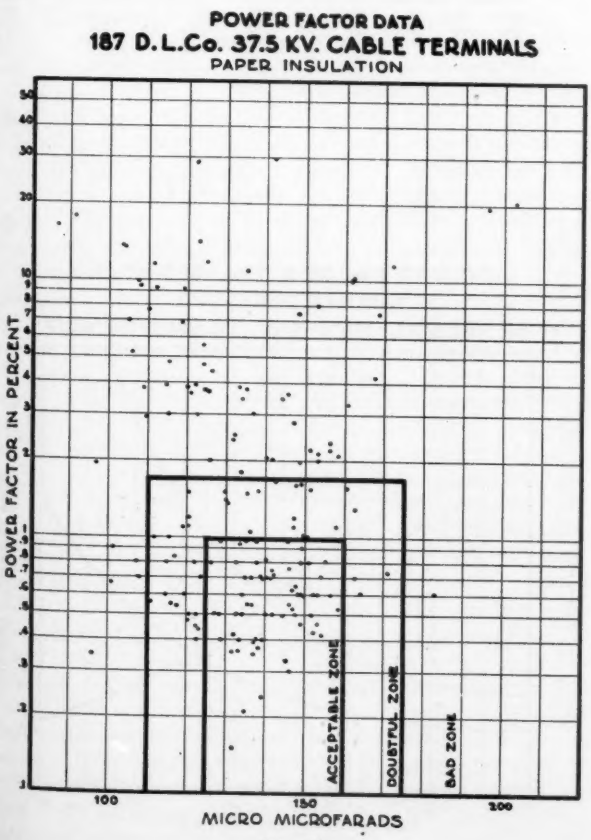


Fig. 3

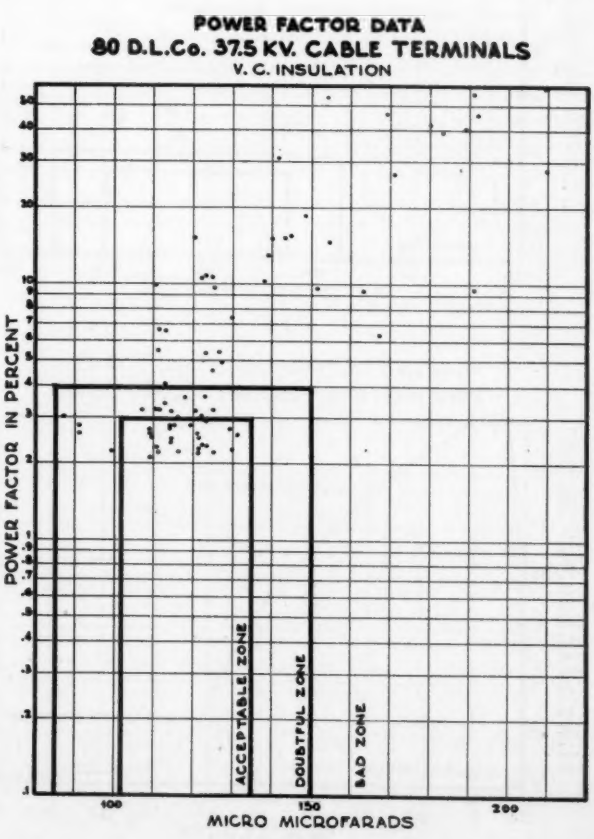


Fig. 4

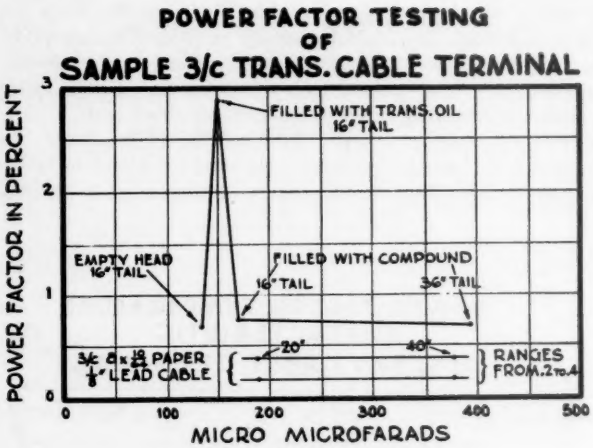


Fig. 5

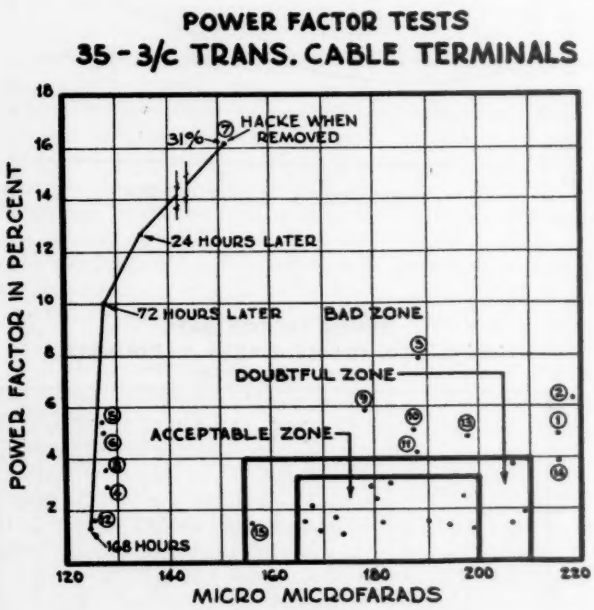


Fig. 6

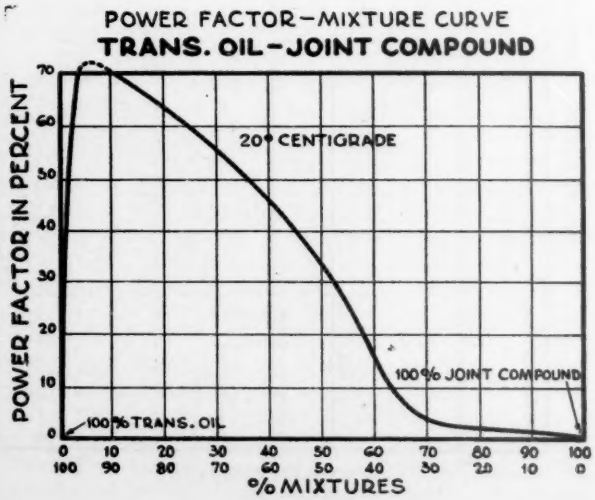


Fig. 7

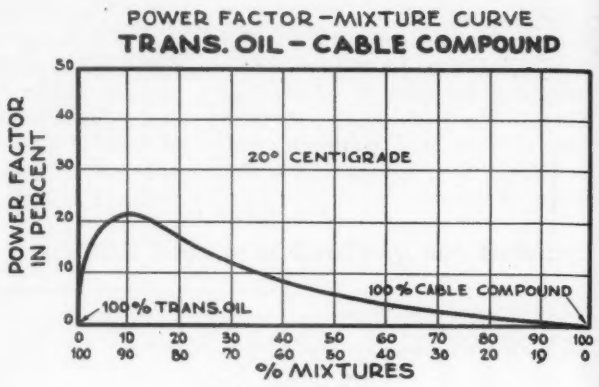


Fig. 8

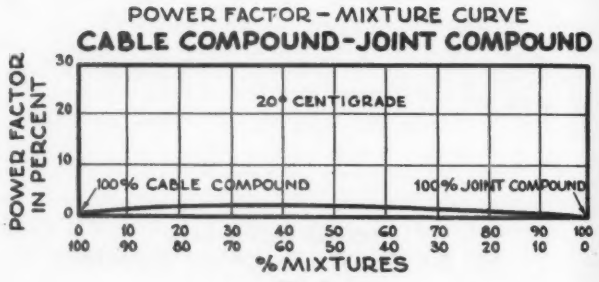


Fig. 9

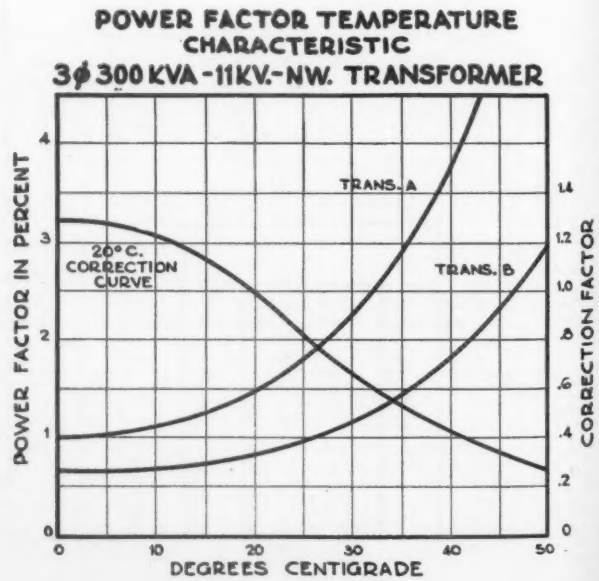


Fig. 10

vanced toward failure. Some of these terminals showed evidence of moisture in large quantities with subsequent charring of the outer conductor insulation. All terminals in this class have been replaced.

Similar information for 80 terminals used with varnish cambric insulated 22-kv cable is shown in the chart in Fig. 4. Like the terminals used on 22-kv paper-insulated cable, a number of these terminals were examined and, as a result, were divided into the same three classes. All terminals falling in the outside zone were replaced. The results seem to indicate greater effect of ionization currents on this type of insulation because of the marked increase in capacity values for defective terminals.

During the two years which have elapsed since the testing of cable terminals were started, no terminal falling within the "satisfactory" or "doubtful" zones has failed.

Transformer Terminal Inspection

Following the failure in service of a three-phase, 11-kv cable terminal mounted on a network transformer, an investigation revealed that the conductor insulation had been badly damaged at the time of installation—approximately nine years previous. The condition was further aggravated by extremely tight taping of the cable during manufacture and insufficient space for bending the cable within the terminal. Transformer oil from the oil-filled disconnect compartment to which the terminal was attached had entered the terminal and mixed with the filling compound.

Because of the successful results experienced in the use of the inverted Schering bridge for testing outdoor line terminals, it was decided to test 35 transformer terminals of the type on which trouble was experienced. Before beginning the field testing, however, certain tests were made to determine as accurately as possible the limits of this field of operations.

A terminal of the particular design in question was properly assembled and the lead sheath "rung" at a distance of 16 inches below the wipe. The conductors were grounded and the power factor bridge connected to the sample with the "zero" voltage lead connected to the three conductors and the "live" lead connected to the body of the terminal. Experimental test results obtained for this terminal are shown in Fig. 5. This figure emphasizes the importance of keeping the physical dimension of test specimens uniform in order that variations in test results can be properly interpreted.

In the field, the lead sheath was "rung" at a distance of 16 inches below the terminal, with the terminal disconnected and unbolted from its mounting. The line conductors were then grounded, and, as in the case of the overhead terminal, the body of the terminal was properly shielded and energized. Readings of cotangent θ and R_3 were recorded, using a test voltage equivalent to one-half normal phase to ground potential, or 3,450 volts.

Since this testing was done in connection with regular transformer inspection, it was possible to make all tests early in the morning when the transformer terminals were all slightly above ambient temperature. Since the actual temperature range was less than that of the outdoor tests previously carried on and the materials involved were similar, it was assumed that temperature was not a factor in interpreting the results obtained.

The information obtained as a result of the testing of 35 terminals of this type is shown in Fig. 6. Subsequent examination of a number of these terminals revealed the fact that none of them contained moisture but that many of them contained transformer oil which had entered, in varying degrees, through defective gaskets. Because of the absence of moisture, it was decided to investigate—to some extent—the effect of mixing transformer oil and cable compound, transformer oil and filling compound, and filling compound and cable compound. The results of these investigations are shown in Figs. 7, 8 and 9.

It will be noted that there is an increase in power factor of large magnitude throughout the middle range of two of the mixtures, even at the temperature of 20°C at which the information was obtained. It is probably this phenomenon which accounts for the increase of power factor of many of the terminals shown as unsatisfactory in Fig. 6. As a result of these tests, a number of terminals were removed from service and carefully examined.

Investigation indicated that the "bad" terminals could be divided into two general classes or groups. Some terminals with a relatively low capacitance were predicted as having voids in the filling compound with power factor values depending upon the degree of contamination of the compound. Terminals 4, 5, 6, 8, and 12 (See Fig. 6) were found to be as predicted. A second group of terminals with relatively high capacitance and power factor were predicted as terminals having a decreased value or thickness of insulation, in conjunction with a power factor in proportion to the contamination of the insulating compound. Terminals 1, 2, 3, 10, 11, and 13 were found to fall within this description. Terminals 7, 9, and 14 were found to be in a very bad condition. Contaminated compound, which was "polymerized" or "emulsified," gave evidence of ionization, and creepage currents and conductor insulation damage at the crotch were found to be very prominent in each of these terminals.

Owing to the relatively small number of terminals of this type, it was rather difficult to establish definite doubtful and bad zones, as was done in the case of the overhead type of cable terminal. However, examination of a few terminals within the limits of .9% to 3% power factor and 165 mmf and 200 mmf allowed the establishment of these values as limits for satisfactory terminals. It was because of the extreme importance of the network system on which these terminals are installed and the desire to obtain as much information as possible that all terminals outside the satisfactory range were examined. Further experience with a larger number of terminals would probably allow the establishment of a definite "doubtful" zone to be rechecked at more frequent intervals than the satisfactory terminals. Testing of other cable terminals will be continued in conjunction with regular transformer inspection.

Network Transformer Inspection

The networks of the Duquesne Light Company are served by a variety of 4-kv and 11-kv transformers ranging in size from 100 kv-a single-phase to 500 kv-a three-phase, several of which have been in service for as long as 15 years. For the last five years, these units have had the space above the oil filled with nitrogen. Complete inspections are made on these units every three years.

Because of previous power factor testing experience and the fact that the method could be used on transformers in conjunction with the regular three-year periodic inspection with slight increase in cost, it was decided to power factor a number of transformer units with a view to establishing the value of this type of testing for determining the condition of transformers.

The results obtained from these tests

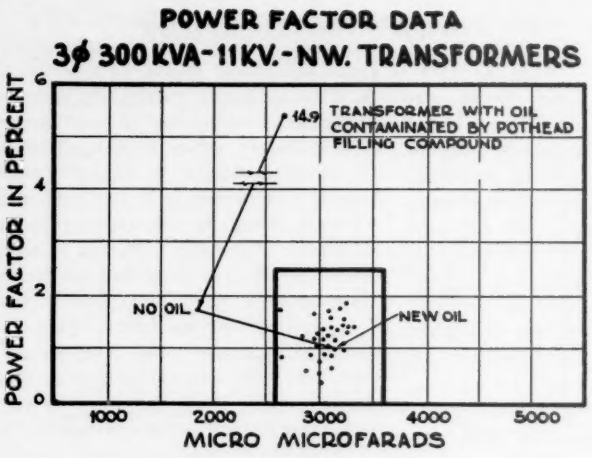


Fig. 11

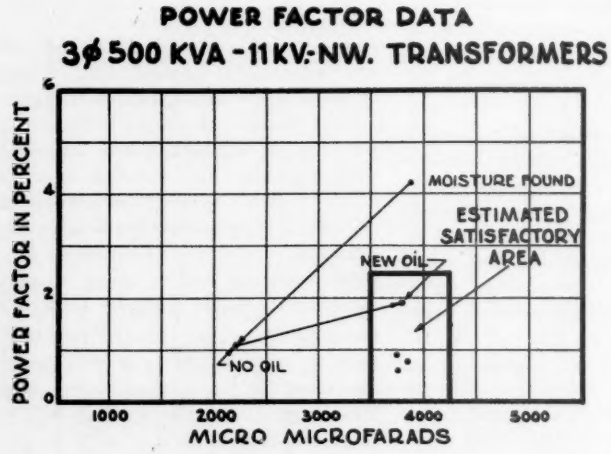


Fig. 12

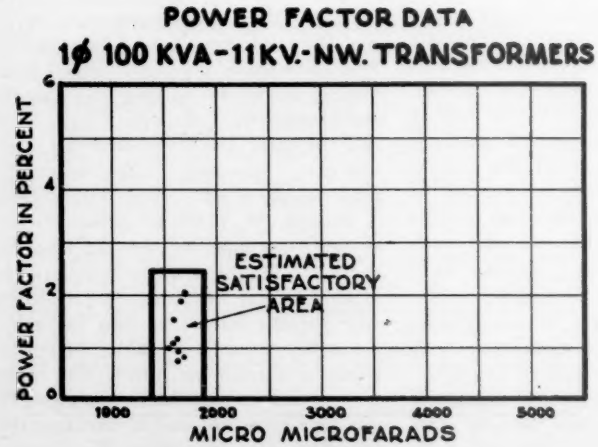


Fig. 13

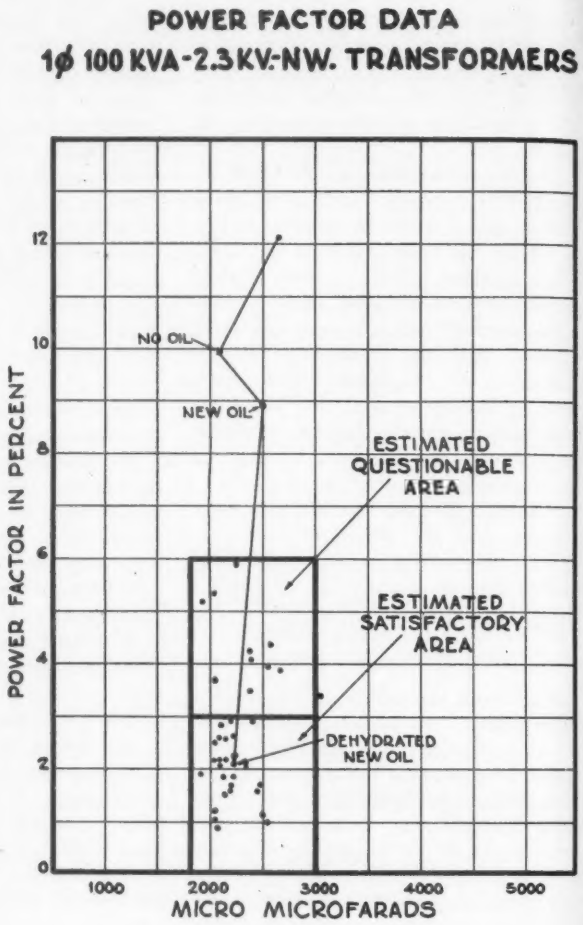


Fig. 14

are not extensive enough, at the present writing, to permit the drawing of many conclusions because of the apparent high quality of most of the transformers thus far inspected and the relatively small number of units tested to date. The information which follows is submitted as a matter of interest and guidance for future work along this line.

Because the effect of temperature variations on the power factor of transformer insulation is greater than that observed in pothead testing, it was thought desirable to convert all readings to an approximate 20°C value. In order to do this, Power Factor Temperature Curves were run on two representative transformers having different power factors, both of which were acceptable. From this information a Conversion Curve was established, giving average correction factors which could be applied to field readings in order to convert them to an approximate

20°C value. This information is shown in Fig. 10.

In the case of transformers, it was possible to obtain such consistent values for most of the units of any given type that it was not difficult to set up a tentative "satisfactory" equipment range. Further experience with this type of equipment testing may allow the establishment of a "doubtful" range, but at the present time indications are that very small amounts of contamination in the form of moisture or foreign compounds give such increased readings that detection of these conditions is not difficult. During the tests, no experience was had with charred insulation on transformer equipment.

Most of the tests have been made by grounding the low voltage winding and measuring the power factor of the high voltage winding against the low voltage winding and ground. The results of these tests are shown in Figs. 11, 12, 13, and 14.

Fig. 11 records results obtained from a group of three-phase, 300 kv-a, 11-kv units, one of which had a power factor of 19.4 per cent. Removal of the oil indicated a satisfactory power factor for the winding, itself, and the installation of new oil showed results which were comparable to those obtained from other satisfactory units. Investigation disclosed the fact that the transformer oil had been contaminated by pothead filling compound. The fact that the winding, without oil, did not show an excessive power factor apparently indicates that the contaminated mixture had not entered the coil insulation.

Fig. 12 shows results obtained from a group of four three-phase, 500 kv-a, 11-kv transformers, one of which was originally found to contain a slight amount of moisture in the bottom of the case. While its power factor, after the installation of new oil, is slightly higher than the other three transformers of the same class, it is believed that it is not sufficiently high to merit concern at the present time. Apparently, most of the moisture in this transformer was in the oil, as indicated by the power factor reading after the oil had been removed. Occasional checks will be made upon this unit for future information.

Fig. 13 indicates results obtained on a group of single-phase, 100 kv-a, 11-kv network transformers, all of which are satisfactory.

Fig. 14 shows results obtained from a group of single-phase, 100 kv-a, 2.3-kv network transformers. One of these transformers, as indicated on the chart, was found to have a high power factor, although there was no evidence of moisture which could be observed in the field. The power factor obtained after the oil had been removed was still of a very unsatisfactory value and indicated that the winding insulation, itself, had undoubtedly been contaminated. The transformer was removed from service and vacuum-dried for a number of days, after which period, with new oil installed, the power factor fell to a very satisfactory value well within representative values of the group to which these transformers belong. Because of the lower operating voltage of this type of unit, the estimated satisfactory area has been made somewhat higher than that for other types of equipment and a "questionable" area established. Units in the latter area will receive further study.

An attempt was made to correlate the age of the individual transformers and the power factor data, but no consistent results were obtained.

Conclusions

From the experience thus far gained, it is possible to draw the following conclusions as to the use of the Inverted Schering bridge for testing cable terminals and transformers:

1. It is possible to detect terminals containing moisture, voids, or a combination of the two.
2. It is possible to detect terminals containing harmful mixtures of transformer oil and filling compounds.
3. It is possible to detect terminals in which the cable has been mechanically damaged or charred with resulting areas of high voltage stress.
4. It is possible to detect transformers containing moisture or other contamination in oil or windings.
5. While no such transformers were found, it is believed that it is possible to detect transformers, the insulation of which has been charred by overloading. Such a condition should result in a decrease in R_a value corresponding to an increase in capacity of the winding.
6. In testing any electrical equipment, the capacity of the various units will naturally vary, depending upon the type of insulation and the physical dimensions involved. If a number of similar units are available, however, there will probably be enough units having similar capacities to indicate approximately what the capacity should be.
7. The acceptable power factor for all of the 11-kv transformer equipment covered in this Report is apparently the same, regardless of size and type of the unit tested. The 2.3 kv equipment, however, tends to run to higher values.

As stated earlier in the Report, the information obtained from transformer testing, to date, is not conclusive but is submitted as interesting data to be used as a possible basis for future studies along this same line.

Correction

The editor regrets that in the account of the 6th annual Convention appearing in the June issue of the BULLETIN it was erroneously reported that Mr. George O. Muhlfeld had "recently retired from the Stone & Webster Corporation and active work in the electric industry." Mr. Muhlfeld has not retired as Chairman of the Board of the Stone & Webster Corporation, but the Corporation itself has withdrawn from participation in public utility managerial functions.

RECENT PUBLICATIONS

TREATING AND INSPECTION OF CREOSOTED PINE POLES

E.E.I. Pub. F-1. A report of the Transmission and Distribution Committee, Edison Electric Institute, 13 pages. Price 30c. to members and their employees; 75c. to nonmembers in the U.S.A.; 85c. to foreign countries.

AT their annual convention in January, 1937, the American Wood Preservers Association adopted new specifications for creosote treatment of southern yellow pine poles. Since these specifications give minimum inspection procedure and penetration requirements and since several alternative penetration requirements are included, the purchaser must make decisions regarding these matters when ordering poles. Some knowledge of the treatment of poles and the variations that may result in the treatment is highly desirable. Also an understanding of the effect of various penetration requirements and inspection procedures on the percentages of poles rejected and upon the cast is necessary in order to apply properly the A.W.P.A. specifications to an individual company's specifications.

This report has been based upon information supplied by treating companies at various committee meetings and test boring data obtained from member companies and from other organizations.

DISTRIBUTION TRANSFORMER LOAD CHARACTERISTICS—1938

E.E.I. Pub. F-3. A report of the Transmission and Distribution Committee, Edison Electric Institute, 80 pages. Price $1.00 to members and their employees; $2.50 to nonmembers in U.S.A.; $2.65 to foreign countries.

THIS is one of a series of four reports designed to provide the test and experience data necessary to encourage and enable the economical loading of distribution transformers. These reports are as follows:

1. "Distribution Transformer Loading" by H. P. Seelye, appearing on page 163 of the

(*Continued on page 352*)

Meeting of the Joint Subcommittee on Development and Research

THE Joint Subcommittee on Development and Research met with its project committees on June 17 in New York, with Mr. Hooven presiding. The various project committees presented progress reports covering the work for the last six months.

In addition to the progress reports three technical reports were presented.

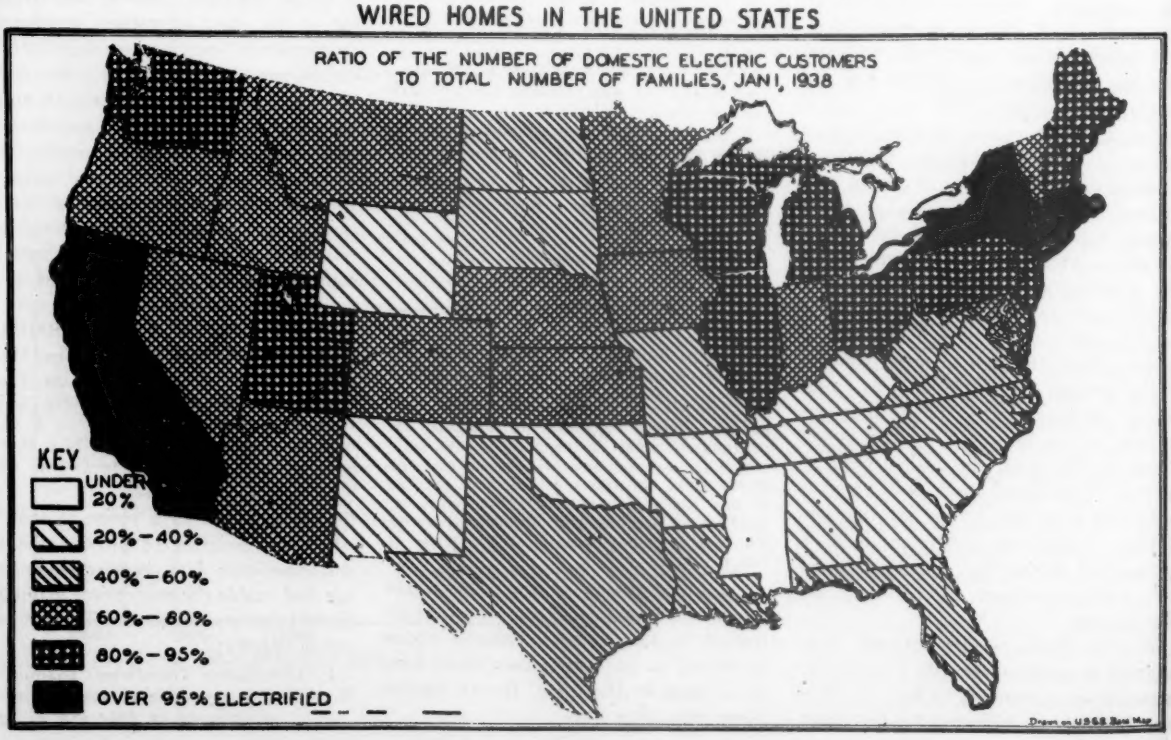
Project Committee 1A—NOISE INDUCTION, presented a technical report entitled "Series Sodium Highway Lighting Circuits." These circuits make use of a new type of lamp which has been developed for highway lighting purposes employing ionized sodium vapor as its luminous element. The wave-shape characteristics of the sodium vapor lamps are such that where series lighting circuits supplying a considerable number of these lamps are involved in exposures with open-wire telephone lines, attention must be given to the coordination of the two systems from the noise standpoint. This report presents the results of an investigation of the various factors involved in situations of this character. Data are included on the wave shape of series sodium circuits and the relative inductive influence of various circuit arrangements. A method of estimating the noise to be expected in a given exposure is described. The process used involves an extension of existing methods of noise calculation to cover the conditions peculiar to exposure involving series lighting circuits. The use of this method of estimating noise is illustrated by an example. Various coordinative measures are also discussed.

Project Committee 2D—SPECIFIC DEVICES, presented a technical report entitled "Short-Circuiting Relay Protectors." This report describes the device known as the Short-Circuiting Relay (SCR) Protector which is designed primarily for application to open-wire telephone lines exposed to low-frequency induction. In this device there is associated with the ordinary carbon protector blocks a relay whose contacts place a short circuit around the blocks within a very short time after the initial discharge, thereby relieving the blocks of the duty of carrying the discharge current during a large part of the discharge interval. Both the unit type and multi-grounding type protectors are described and the fields of use for both are covered. A practical method for planning an installation of SCR protectors along open-wire lines for the purpose of limiting voltages to ground due to low frequency induction is outlined and a discussion is given of results obtained in field tests and trial installations.

Project Committee 2G—CONSTRUCTION, presented a technical report entitled "A Study of Pole Strength for Jointly-Used Lines." This report contains the results of a study that has been made of a number of jointly-used pole lines in areas having different service requirements and located in different parts of the country, with the object of comparing the sizes of wood poles in lines as they were constructed, with the sizes of poles required by the existing loads, taking account of the present general use of treated poles and present ideas of adequate strength requirements. The study has been based solely upon the pole loads as found. Such factors as future growth, relative costs of poles of different sizes, and other intangible factors that vitally influence the design of any particular pole line have necessarily been eliminated from this general study.

The technical report of Project Committee 2D was recommended for issuance as an Engineering Report and those of Project Committees 1A and 2G as Provisional Reports. Announcement will be made in the BULLETIN when these recommendations are acted upon by the Joint Committee on Plant Coordination.

WIRED HOMES IN THE UNITED STATES



P.U.A.A. Meets in Detroit

NEW trends in the presentation of public utility advertising were explored by the Public Utility Advertising Association at its annual meeting held in Detroit June 24. Discussions centered around the use of symbols, slogans and trade characters, as well as type of presentation of the company's message to customers.

During the meeting awards in sixteen classifications were made in the better copy contest, conducted annually by the association. Companies from New York to California, from Detroit to Florida and the Gulf shared in the awards.

Weeks Elected President

Howard Weeks, Consolidated Edison Company of New York, was elected president of the association, succeeding Kenneth Magers, Cincinnati Gas & Electric. E. K. Hartzell, Lake Shore Electric Railway, was elected first vice-president; Harold J. Rowe, Iowa Electric Light & Power, second vice-president; Al C. Joy, Pacific Gas & Electric, third vice-president; Thomas H. Spain, Public Service of New Jersey, treasurer, and H. W. Olcott was re-elected secretary.

Mr. Magers, retiring president, and S. J. Ballinger, San Antonio Public Service, were elected directors for one year. Directors elected for a three-year term included E. Frank Gardiner, Commonwealth Edison; J. R. Pershall, Public Service of Northern Illinois, and Miss Clara H. Zillessen, Philadelphia Electric.

Companies winning first honors in all sixteen classifications follow:

No. 1—Load building, newspaper advertising of electric companies: Hartford Electric Light Company.

No. 2—Public relations newspaper advertising of electric companies: Pacific Gas & Electric Company, San Francisco.

No. 3—Merchandise newspaper advertising for electric companies: Florida Power & Light Company.

No. 4—Load building, newspaper advertising of gas companies: Peoples Gas, Light & Coke Company.

No. 5—Public relations newspaper advertising for gas companies: Peoples Gas, Light & Coke Company.

No. 6—Merchandise newspaper advertising for gas companies: Consolidated Edison Company of New York.

No. 7—Newspaper advertising to increase business, transportation companies: New Orleans Public Service, Inc.

No. 8—Public relations newspaper advertising for transportation companies: Wisconsin Public Service Corporation.

No. 9—Employees magazine: Detroit Edison Company.

No. 10—Employees newspapers: Cincinnati Gas & Electric Company.

No. 11—Bill inclosures, customer publications envelope and package inserts for public utilities companies: Boston Edison Company.

No. 12—Direct mail advertising for public utility companies: Georgia Power Company.

No. 13—Window or inside displays for electric companies: Cincinnati Gas & Electric Company.

No. 14—Window or inside displays for gas companies: Southern California Gas Company.

No. 15—Poster advertising for all utility companies: Boston Edison Company.

No. 16—Radio advertising for all public utility companies: Southern California Edison Company.

Henry Obermeyer, Consolidated Edison of New York; T. F. Gessner, Detroit Edison; Fred Toy, Cincinnati Gas & Electric, and C. E. Hooper, of C. E. Hooper, Inc., New York, addressed the convention sessions.

Miss Zillessen, advertising manager of Philadelphia Electric, won the Josephine Snapp award for 1937, a silver vase presented annually by the Women's Advertising Club of Chicago to the woman making the outstanding contribution to advertising during the foregoing year. Presentation of the award was made by Mason Britton, chairman of the Advertising Federation of America and vice-chairman of McGraw-Hill Publishing Company.

Alex Dow, president of Detroit Edison, discussed at the opening meeting the value of advertising to a utility.

Canadian Electrical Association Convention

WITH an attendance of about 375 the 48th Annual Convention of the Canadian Electrical Association, held at the Log Chateau, Seigniory Club, Quebec, on June 21-24, proved to be one of the best in the history of the Association, both in attendance and in papers of unusual interest.

President R. H. Mather, in his opening remarks urged that greater attention be paid to employee and public relations. "The people," he said, must not be allowed to lose their faith in industry owned and managed by private endeavor."

Four Main channels of education, in which to work for best results, were outlined by Mr. Mather. First and most important is the systematic, constant training of the staff. Next, tell the customer the facts, make rate structures simple and make accounts easy to understand. Then be sure that the investors understand what the company is doing and how it is doing it. And finally, educate the public through high calibre institutional advertising.

"We, along with the rest of the world," he said, "are passing through troublesome times. They started soon after the close of the World War. There is a change going on about us and it behooves us to give heed to it. Spending by governments is increasing annually—and for items which did not appear on the accounts ten years ago—debts are increasing by leaps and bounds, taxes have gone beyond what we believed a few years ago were limits. There is a tendency to seek government aid for all sorts of ills which we used to feel we should cure by ourselves. Unemployment is a serious problem which is not to be solved by governments alone if we are to retain our leadership and our solvency. There is the question of the proper training and absorption of youth into our industrial and professional life. These are all matters of the utmost importance to us and require immediate consideration and action before the initiative is taken out of our hands."

Mr. Mather also touched on other phases of electric utility operation. During the year, for instance, he pointed out that the association had the chance to present the general facts regarding the taxing of electric utilities before the "Rowell Commission," and hoped thereby that some uniform system of taxation would result throughout the Dominion.

He drew attention to the work of the Canadian Engineering Standards Association and especially to the work of that body in drawing up the electrical code. In his opinion, he believed that the electric power companies have not taken sufficient interest in this work, nor had they

been adequately represented upon the revising committees.

Considerable interest was shown in the remarks by D. M. DeBard on small non-pressure water heaters for localized use such as are being used in different places in Europe. Mr. DeBard, who officially represented the Edison Electric Institute, spoke on "Room to Grow," indicating opportunities in each of the three major classes of sales.

Miss Margaret Nevins, Central New York Power Corporation, Syracuse, outlined the ramifications of home service work. A series of spectacular demonstrations of new developments in polarized lighting, electronics, insulation, dust control, etc., were made by Dr. Phillips Thomas of Westinghouse. D. W. McLenegan of General Electric discussed the market for air conditioning, presenting charts showing load characteristics.

A simple explanation of the effect of counterpoise for protection against lighting disturbances was made by L. V. Bewley, General Electric. B. K. Boulton, Beauharnois Light, Heat & Power Company, showed several oscillograms of experience with three 132-kv air blast breakers.

These papers were interspersed with the commercial, engineering and operating committee reports. In all, the association has some twenty-one active committees.

One of the features of the convention was the "Watts-the-Mather Club," which took the place of the room entertainment of previous conventions. Hours were limited to times when meetings were not in session.

At the Annual Banquet the winners of the annual merchandise sales competition were announced as follows:

Class I (over 10,000 meters) Winnipeg Electric, with average sales of $9.50 per customer;

Class II (2,000 to 10,000 meters) Canada Electric, Amherst, $20.55 per customer;

Class III (750 to 2,000 meters) Southern Canada Power, Waterloo, $25.68 per customer;

Class IV (less than 750 meters) Gatineau Power, St. Jovite, $42.30 per customer.

M. C. Gilman, commercial manager, Winnipeg Electric Company, was elected president for the following year.

CONVENTIONS AND MEETINGS

AUGUST

29-31 Illuminating Engineering Society, Nicollet Hotel, Minneapolis, Minn.
29-31 Rocky Mountain Electrical League, Canyon Hotel and Lodge, Yellowstone Park, Wyo.

SEPTEMBER

1 Illuminating Engineering Society, Nicollet Hotel, Minneapolis, Minn.
7-9 Pennsylvania Electrical Association, Bedford Springs Hotel, Bedford Springs, Pa.
12-15 National Electrical Contractors Association, Book-Cadillac Hotel, Detroit, Mich.
12-15 International Municipal Signal Association, Lord Baltimore Hotel, Baltimore, Md.
15-16 Empire State Gas and Electric Association, Lake Placid Club, Lake Placid, N. Y.
19-20 Wisconsin Utilities Association, Transportation Section, Lawsonia, Green Lake, Wis.
22-24 American Trade Association Executives, William Penn Hotel, Pittsburgh, Pa.
23-24 Wisconsin Utilities Association, Accounting Section, Lawsonia, Green Lake, Wis.
29-30 Indiana Electric Association, French Lick Springs Hotel, French Lick Springs, Ind.

OCTOBER

1 Indiana Electric Association, French Lick Springs Hotel, French Lick Springs, Ind.
3-6 American Transit Association, Toronto, Canada.
3-6 American Transit Association, The Royal York Hotel, Toronto, Can.
3-7 National Restaurant Association, Chicago, Ill.
5-9 Electrical Manufacturers Club, The Homestead, Hot Springs, Va.
10-11 Electrical Equipment Committee, EEI, Chamberlain Hotel, Old Point Comfort, Va.
10-14 American Gas Association, Atlantic City, N. J.
10-14 National Safety Council, Stevens Hotel, Chicago, Ill.
11-12 Transmission and Distribution Committee, EEI, Chamberlain Hotel, Old Point Comfort, Va.
17-20 National Electrical Wholesalers Association, Drake Hotel, Chicago, Ill.
24-28 National Electrical Manufacturers Association, Palmer House, Chicago, Ill.

Recent Publications

(*Continued from page* 349)

minutes of the meeting of the T. & D. Committee, Edison Electric Institute, in Chicago, on May 5, 1937.

2. "Thermal Performance of Distribution Transformers" by Merrill DeMerit, at the meeting of the T. & D. Committee, Edison Electric Institute, in Pittsburgh, on April 18, 1935.

3. "Distribution Transformer Loads" (this report).

4. "Field Testing of Distribution Transformer Loads." (Investigation in progress.)

The report under review records the results of an investigation made to determine the kinds of loads that occur on distribution transformers and to indicate methods of analyzing their heating effect on the transformer. The chief purpose is to establish a basis for the most economical distribution transformer loading under all conditions. That loading must be such as to avoid capital loss due to underloading on the one hand and excessive depreciation due to overloading on the other. A second purpose is to furnish data which may aid in the determination or development of the most economical and satisfactory load testing methods and equipment. The essence of this report is included in individual records of kv-a hour loads on each of the thirty-five distribution transformers, made from graphic ammeter charts for one week in each of the four seasons of the year.

The range of transformer sizes is from 5 to 50 kv-a. The kinds of customers served include low-grade residential, medium-grade residential, combined low-grade commercial and residential, and high-grade residential. Geographical diversity was obtained by having some of the tests made in each of the following states: Pennsylvania, Georgia, Tennessee, Michigan, Nebraska, and Washington.

The range of effects of high, low, and promotional rates and load building activities are incorporated by including tests on transformers serving poor-grade residential customers using only lights, and up to transformers serving in areas where refrigerator, range, and water heater saturations are 80% to 90%.